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Thesis

EVOLUTION OF PARENTAL CARE

by

Pearle Christine Huckins
(A.B.,Bates,1924)
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requirements for the degree of
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Chapter One

Parental Care

Instincts for the Care of the Young

> "Instincts for the care of the young extend far down in the animal kingdom and their origin therefore dates back to an early period in the history of the earth. The important rôle which these instincts have played in the evolution of animal life,--a rôle which has increased in importance as animals have become more highly evolved,--renders the subject of their origin and course of evolution one of special interest to the comparative psychologist." (1)

To him it is of particular interest to determine the manner in which animals came to care for their offspring, and to show in what way parental care has been concerned in bringing about the more advanced stages of the evolutionary process.

The Institution of Parental Care

In many ways, especially in "its relation to social and ethical evolution" (2), parental care as an institution has been fundamental for the higher stages in development. It is undoubtedly true that with the expansion of the family organized societies usually have their beginning. In considering some of the insects, taking as examples the ants, bees, and social wasps, there may be

1 S.J.Holmes, Studies in Animal Behavior, p.35
2 Ibid.

traced different stages which are apparent "between the single family and the highly organized social state". (1) Many insect communities are composed simply of an enormous family having as its origin a single female parent; "when the community includes more than this the condition is generally a secondary outgrowth of the domestic group." (2)

The first traces of altruistic instinct probably reflect back to the care on the part of parents for their young. No family life in the true sense may exist which has as its basis a purely egotistical attitude. There must be existent some altruism even though its scope may be weak and limited as well. In the lower forms it is confined to the care of the offspring; later it may be extended to other members of the species, outside the limits of the family, but it takes considerable time for this to come about. Most individuals have no consideration for the welfare of any outside their own immediate kin; where there is consideration for alien forms, as when ants foster aphids, we soon conclude that such attention is bestowed because of something by way of return. Animals, generally speaking, live under conditions of such a sort that

1 S.J.Holmes, Studies in Animal Behavior, p.36
2 Ibid.

they cannot be benevolently disinterested.

> "While the long hard struggle for existence may have bred tender feelings and unselfish impulses, it has produced them for the same ultimate purpose that is subserved by sharp claws and good teeth,--the survival and perpetuation of the species." (1)

As one of its devices whereby the survival of the race may be made certain, nature has provided parental care. It has been a device deeply influencing the course of evolution in the higher mammals in particular.

1 S.J.Holmes, Studies in Animal Behavior, p.36

Chapter Two

Steps in the Evolution of Parental Care

The Gradual Appearance of Parental Care

> "Gradual as the incoming of spring has been the blossoming of parental love among animals. We cannot tell in what forms it first appeared in distinctness. We cannot say Lo here! or Lo there! for it is latent in them all." (1)

A survey of the animal kingdom in a comparative way makes it possible to arrange with some measure of probability the main outlines of its development. The offspring of the lower invertebrates must fend for themselves as soon as they come into existence. Occasionally such things as brood pouches serve as sources of protection for the eggs or young, but there is apparent no active care on the part of the parents for their offspring until we reach the higher invertebrate animals. An illustration of this is offered by an amphipod crustacean, Amphithoe. This creature carries its eggs, and later its young for a few days after they are hatched, in a brood pouch on the under side of its body. As soon as they are active enough the young leave this container and swim away; the mother gives them no further attention. In fact, due to the car-

1 J.Arthur Thomson, The Study of Animal Life, p.105

nivorous habits of this particular species, it would be dangerous for the young to linger for any great length of time in the vicinity of the parent. Some authorities picture the female scorpion as helping the little ones to hatch by removing the egg membranes with her jaws; at once the tiny fellows mount upon the mother's back to be carried about by her in safety. The spider Lycosa carries her cocoon about with her and, when the spiderlings hatch, allows them to cling to her body. She neither feeds nor cares for them in any way, but simply seems to allow them to ride about.

Formation of Instincts to Secure the Proper Environment for the Eggs

There is much evidence supporting the belief that the formation of instincts to bring about suitable environment for the development of the eggs was the first step in the evolution of parental care.

> "Instincts for depositing eggs in places which afford food for the young, instincts for making cocoons or other receptacles for the eggs, and instincts for concealing the eggs from attacks of other animals are common in animals which are too primitive to exhibit any care for, or even recognition of their offspring." (1)

Certain molluscs have been observed to spread their eggs over the surface of aquatic plants or to

1 S.J.Holmes, Studies in Animal Behavior, p.38

bury them in gelatinous masses in the sand, having no idea as to the free swimming larvae which will develop from them. The bot fly deposits its eggs upon the hairs of horses and cattle, while the May-fly leaves its eggs in a pond or stream; yet it seems rather absurd to assume that any of these creatures has the least notion about the larvae to which the eggs will give rise, even less of the relation which the environment of the eggs has to the needs of larval life.

Formation of Instincts to Provide for the Needs of the Larvae

Some species of the solitary wasps go a step further in that the female, in order that her larva may have a source of nourishment when it hatches, deposits in a hole, which she has dug, food in the form of a spider or caterpillar, depending on what species of wasp she may be. She proceeds to fill up the hole with dirt and never returns to the spot. Some of the beetles behave in a similar manner. We may explain this as an instinctive act in a sense blindly performed, since the parents do not actually have any part in caring for their progeny.

Appearance of Instincts for More or Less Continuous Care of the Eggs

Later there are evident instincts for the care

of the eggs after they are laid. The running spider will rescue her cocoon if it is taken, though she treats with indifference the young coming from the egg mass. There are some cases where fishes stay for a long time with their eggs; this is especially true of those fishes that spend much time in making a nest, for example the sticklebacks and the common dogfish, Amia.

The Amphibia with their queer breeding habits display primitive instincts for protection by staying close by their eggs during the period of early development. The newt Desmognathous remains near the eggs as they lie in a hollow place. "The snake-like caecilians coil about their egg masses, while certain species of frogs carry eggs in pouches on the back or in sacs connected with the throat." (1)

The reptiles considered as a group show little concern for their offspring, probably because the latter can ably take care of themselves from the first. Alligators guard the spots where their eggs lie buried. Pythons afford warmth for their eggs by coiling about them.

One may refer to some of the species of birds as being outstanding in their manifestation of care

1 S.J.Holmes, Studies in Animal Behavior, p.40

for and protection of their eggs.

Extension of Care of the Eggs to What Comes out of Them

A further step in the evolution of parental care was brought about when there appeared the extension of the care of the eggs to that which issued forth from them. Not much other than a feeble beginning of this is exhibited in some of the arachnids. In most insects provision is made for the eggs; in rare cases are the parents other than indifferent to their young. Social insects, such as ants and bees, give their grubs the best of care. The solitary bees and the more primitive social species provide for the whole life of the larvae when they lay their eggs, and then leave. In the more highly developed social groups, taking for example the hive bees and some of the ants, instincts for taking care of the larvae become more specialized and complex.

Several species of fishes that take some care of their eggs display no special concern for their offspring which disperse immediately upon hatching. In other cases like the common dogfish, Amia, the young brood is protected.

As care comes to be extended from the eggs to the young there prevails the bestowing of more and

more care upon the offspring as we pass to the higher forms. Instead of a large number of progeny shifting for themselves and a resultant great loss of life, there is a decrease in the number of offspring with an increase in the care and attention bestowed upon each. The young become more and more dependent upon the parents, and for a longer period. Sympathy, affection, and the different emotions evidenced by family relations become more prominent.

Among the birds we may note the various stages. Some birds either make no nests or crude ones at the most, because their young are quite active and not in need of the parents' solicitude. The higher song birds prepare with care a nest in which the dependent little ones may remain to be fed and looked after for some time.

Likewise among the mammals there occur similar stages. The mother tolerates her offspring in suckling it. Resulting from the close association between parents and offspring there have been evolved mammary glands and other adaptations for convenience in supplying the young with nourishment.

In the case of the mammals the affection of parents for their young usually disappears at the

close of the period of infancy. The young are then able to venture forth for themselves and the parents turn their attention to the interests of the species.

As regards our simian cousins the period of infancy is extended for a longer period of time. Some of these animals in their display of affection for their children may be compared with the most devoted human parents.

Wide is the gap between the egg-protecting instinct of primitive animals and the affection displayed by an ape for its young. The instinct, however primitive, and the most developed affection lead to the perpetuation of the race. The life process is dependent upon both for its continuation and maintenance.

> "The two phases of this process represented by selfpreservation and race preservation have become elaborated pari passu in the course of evolution.. ..,parental care and all the social and ethical instincts to which it forms the preparatory stage of development may be regarded as an outgrowth of the process of reproduction. To the simple acts of egg laying there came to be added other activities which make for the welfare of the progeny, leading on to active solicitude for the young, and thence to social instincts which finally blossom out into the rich endowment of altruistic emotions and sentiments of highly evolved social life. It is in reproduction, which is essentially an altruistic activity, that we must seek for the roots of altruism. Egoism and altruism in their primal manifestations are coeval rather than successive phenomena. The primitive organism which grows and divides by fission

shows us the germ of both of these traits." (1)

1 S.J.Holmes, Studies in Animal Behavior, p.48

Chapter Three

Parental Care among the Lower Invertebrates

Parental Care among the Crustaceans

All the crustaceans show a considerable amount of advancement in the reduction of the number of eggs and, too, all show the very beginnings of parental care. The mothers of some of the fish-lice attach their eggs to weeds or stones beneath the water. The female of most of the crustaceans transports her eggs in a brood pouch or in a special chamber made from the flaps that protect the external gills. The summer eggs of the little water fleas (Cladorca) hatch in a brood-pouch under the shell on the mother's back. There are many cases where the eggs are carried in pouches which are fastened to the body of the parent.

Among the sandhoppers and slaters there is a further reduction of the number of the young, so that the embryos carried in brood-pouches are given food and protection until they reach nearly the adult stage. As regards the higher crustaceans, such as shrimps and prawns, crabs, lobsters, and crayfishes, the eggs are found to be rather numerous and cemented to the under surface of the body of the mother and form what are called "ferries". As

soon as the eggs of the marine crustaceans hatch, the larvae leave and seek their own living. Yet, among the fresh-water forms, for example the crayfish, it is found that the eggs are much larger proportionately to the size of the animal and are much less numerous. The entire development of the individual occurs before the time of hatching, as the mother is carrying the eggs. The young appears as a complete image of its parent to enjoy maternal protection still longer as it clings to its parent's tail with its pincers. Adaptations of such a sort afford a lengthened physical contact between the parent and offspring. Sometimes the young are suspended from a jellyfish, or hidden in tents of spines, as is the case with some of the sea-urchins. Fastened to its naked ventral surface are the young of the common little leech (Clepsine). Half buried in the skin are the offspring of one or two sea-anemones. The young of some of the marine worms are carried among modified tentacles. Within the gills of bivalves may be seen their young.

Parental Care among the Arachnids

Among the more interesting features in the life of spiders is the manner in which the females provide for the care of their young. Variety is

exhibited here as it is in other respects in the economy of these creatures, one spider employing methods widely different from those used by another. Yet, there is discernible within each family a noticeable degree of uniformity in the plan that is adopted, in spite of the fact that in the case of each species there is a definite way of developing the plan.

Preparations for the Development of the Eggs

Spiders never lay their eggs singly; they deposit them in one or more masses, for each mass there being a covering of silk, an egg-sac, or a cocoon, the type of covering differing with the species. "Most spiders deposit all their eggs at one laying and enclose them in a single sac; but in certain species the egg-laying is extended over a considerable period of time and a series of egg-sacs is formed." (1) This is true of *Metepeira labyrinthea* and of the species of Cyclosa.

The Egg-sac

By no means is the egg-sac a covering only, made in a haphazard fashion; it is a structure on the whole elaborate, made in a definite manner characterizing the species. The simplest kind of egg-

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1 John Henry Comstock, *The Spider Book*, p.210

sac is that fashioned by Pholeus, which is a mesh of threads holding the eggs together and through which the eggs may be seen. Some species of Aranea construct a fluffy mass of silk having no definite outline, in which to enclose the eggs. *Miranda aviantia* produces an egg-sac of definite form. In this type, when opened, the eggs are found enclosed in a silken cup, around which is a thick layer of flossy silk. This silky mass is furnished with a brown outer covering which is firm and closely woven, giving this sac the characteristic shape of a pear. Some outer coverings conceal the eggs, others are translucent. Sometimes a protecting layer is added which may consist of loose bark from a dead tree, the material used by *Agelina naevia*, or bits of rubbish. Such cases may be found underneath a stone or a piece of wood on the ground. Tetragnatha makes a coating of twisted tufts of silk of a color different from that of the rest of the egg-sac. This sac is placed inside a rolled leaf, with the petiole fastened,--usually very securely,--by a band of silk to a twig. With the making of the egg-sac and the fastening of it in place, there comes to an end the maternal duties of the spiders constructing these sacs. The parent soon dies and the spiderlings from the moment

that they hatch must seek out their own means of existence. With certain spiders, however, this is not found to be the case.

The female of some species of Dictyna establishes her egg-sac within the web. The young soon hatch and remain with their parent for some length of time. Here the mother affords them protection from attack and saves them the trouble of making a web of their own in which to catch their prey.

Indeed, more worthy of notice than the above-mentioned are the evidences of maternal care which are exhibited by the nursery-web weavers, Pisauridae. These spiders do not spin webs for catching insects but stalk their prey. The female constructs an egg-sac which, attached beneath the body, she conveys with her on her travels. When the spiderlings are on the point of emerging from the sac, the mother carries "it to the top of some herb or to the tip of a shrub, and fastens it in the center of a nursery made by spinning a web over the leaves. She then posts herself as a guard on the outside of the nursery." (1)

The wolf-spiders, Lycosidae, are found to carry their egg-sac along with them as they stalk their prey. With reference to this species the egg-

1 John Henry Comstock, The Spider Book, p.212

sac is dragged after the spider and would seem to be a more convenient method than that used by the nursery-web weavers. If the wallet perchance drops off, it is soon replaced. No nursery is made in this case and the spiderlings upon emerging from the egg-sac climb to their mother's back and ride about in papoose fashion for some length of time. If any tumble off the mother takes no notice of them; they climb up again if there is time or opportunity, otherwise they must wait for the next Lycosa. To speak here of mother love Fabre considers extravagant. The mother not even makes an attempt to feed her young, neither inviting them to come to partake, nor placing any broken victuals for them.

The Clotho spider places its eggs in pockets in its home and proceeds to sit on them. The young hatch, but continue within their nurseries throughout the winter. The mother during all this time knows her children only by the trepidations which she experiences through the partitions of the tiny chambers. In June the young ones are undoubtedly assisted in coming forth by the mother who pierces their cell walls that they may leave their place of imprisonment.

The Penduline spider exhibits her devotion as

she spends week after week in a squatting position at the bottom of her purse, pressing "to her heart those little white pebbles from which the warmth of her body will bring forth life." (1) The crab spider assumes her duty constantly. During the incubation period she nearly wastes away. At the least disturbance or provocation she rushes forth with a threatening gesture of her limb at a passing stranger and thus warns him not to trespass. She then disappears. Night and day she protects her precious eggs by spreading her body flat over them. Taking no food, never relaxing, never moving, she is as assiduous as the brooding hen. The young emerge at the end of two or three weeks, and the devoted parent, having experienced the pleasure of seeing her family, aids the weaklings through the trap-door that each may go his own way.

In order to observe the species Dolomedes fontanus, Comstock kept several females with their egg-sacs confined. When the spiderlings began to come out, a nursery was made by the parent. During such a time there was evidence that the female offers protection to her young. Upon the insertion of a pencil into the cage some distance from a female

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1 J.Henri Fabre, The Life of the Spider, p.104

on her nursery, the latter rushed in its direction and grasped it fiercely, repeatedly doing this as often as the pencil was put near her.

In connection with these observations adults were not seen to feed the young; but young ones were frequently noticed feeding upon other members of the brood.

Following the moulting period, the spiderlings left the nursery to migrate elsewhere, the period that they remained in the nursery varying from three to six days.

In summary of the observations which have been made by Comstock with reference to the parental instinct among the spiders, we may refer to a statement made by Holmes where he asserts that the "mother does not feed or actually care for the young in any way, perhaps with the exception of protecting them, and it is doubtful if maternal care goes further than a sort of good-natured tolerance" (1) of their presence for a short time.

1 S.J.Holmes, Studies in Animal Behavior, p.38

Chapter Four

Parental Care among the Insects

Parental Care among Insects in General

"But it is among the insects....that we may see the best examples of parental care in backboneless animals.... What shall we say of the worker-bees" (1) who, in the absence of the care usually bestowed by parents, nurse the grubs constantly; "or of the likewise sexless worker ants whose first endeavor when the nest is disturbed is to save, not themselves, but the young; or of the care that flies, moths, and other insects will take to lay their eggs in substances and situations best suited for the future young?" (2) It is necessary to consider the past history of conditions relating to climate and other situations, if one would understand the provisions, in many cases elaborate, which the female insects make for the young they will never see. It is probable that the ancestors of these insects had a longer life and were rewarded for their efforts by being allowed to look upon the result of their labours; while now there exists inherited habit with the probable absence of a vision of the future. An

1 J.Arthur Thomson, The Study of Animal Life, p.108
2 Ibid.

Ichneumon fly (Polynema natans) has been observed to remain beneath the surface of the water for twelve hours, although not adapted for such a habitat, swimming about with her wings that she might lay her eggs within the larvae of caddis-flies. Howard makes mention of a group of true bugs, the female of which deposits her eggs on the back of the male, in this way compelling him to serve as an animated baby-carriage.

Parental Care among the Solitary Insects

Even the solitary insects provide to a certain extent for their young by depositing their eggs in a place suitable for their development. Among the lower orders of insects these situations are only an environment, somewhat indefinite, such as the soil or the water, where the young must gain their own means of subsistence. Most of the lower Hymenoptera, for example sawflies and gall-flies, lay their eggs on certain plants, upon which the larvae may feed. Some of the solitary wasps and bees, however, arrange nests in burrows in sandy-banks, in the piths of plants; others make nests or tubes, as is true in the case of the mud-dauber wasps. The short-tongued bees make nests in the ground. Some of the solitary long-tongued bees (Apidae) also make their nests in the ground; others

fashion nests of mud, which they fasten to stems of plants. Some bore holes in wood; still others go to the length of padding their nests with cut pieces of leaves with which the cells are lined and covered. Some of the beetles, too, make noticeable provision by way of nests for their young. Within all such nests as these there is stored an amount of food of a particular sort for the larvae.

Parental Care among the Beetles

Some beetles are remarkable in their apparent forethought for the welfare of their young. With reference to the dung beetles we may note with an amount of surprise the digging of a tubular gallery which may reach five feet straight down into the earth--this work being done by both male and female--, the entrance of the female into the gallery to receive the pellets of dung, that have been made previous to this performance, rolled down by her mate and to tear them apart and pack the pieces down, as if in a silo, till they form a mass as big as one's finger. In each of the galleries that branch off the main shaft an egg is laid and within the burrow and feeding upon the dung the female stays for five months at the end of which time the brood comes forth and crawls

up to the surface.

When the young of Copris lunaris come forth from their chamber, both parents escort them to the surface. Emerging beetles of Passalus cornutus are guarded and fed by the parents till they are fully mature. The parents in this particular instance triturate the rotten wood of the log in which they live and treat it with digestive secretion, making it proper food for the larvae whose mouths are yet too feebly developed for such purposes.

Not so outstanding is the care on the part of Phrenapatus bennetti. In a cylindrical gallery, one and one half feet long with roomy niches at intervals along the sides, the larvae hatch and feed on fine, elongate shavings which the parents have provided for them.

The young of Pterocyclon mali and Pterocyclon fasciatum are raised each in its own separate crib, which they leave only when full grown. The parents prepare with great care a fungus bed upon which the larvae may feed. The mother beetle is found in constant attendance and jealously on guard. Not only does the mother supply her offspring with plenty of food but removes all excretions from the nest as well.

Parental Care among the Solitary Wasps

The habits of the different species of solitary wasps vary a great deal as regards nests. The "miners" dig tunnels in the earth. The "carpenters" cut tubular nests in wood and aptly partition these tunnels off into cells with mud. The "masons" construct oval nests of mud, which they fasten to twigs of trees, to the sides of buildings, or to similar objects. The Sphecidae make their nests of mud arranged in several tubes under the eaves of buildings and in barns, attics, and other such places. Within each tube is placed a spider. Some families of digger-wasps make their nests in the pith of plants or even bore into more solid wood. Sometimes they make use of a burrow which has been deserted by some other insect and provision the nest with flies, spiders, and various insects. In every case a cell is supplied for each larva.

At the time of egg-laying the female Bembex wasp captures her prey, a two-winged fly, either killing it or only paralyzing it, puts it in the nest, and lays her egg upon its sternum. The dislocation of the wing is considered by some observers a device for preventing the fly from being turned over by the very young larva, and thus insuring the latter against contact with the rough

sandy floor of the cell. Usually she closes the hole and seems to have no more interest in it; on she goes to make more nests. Such is the belief of the Peckhams as to the supplying of food, but Wheeler states that the wasp supplies food daily. With some genera there exists a longer connection with the offspring. Ammophila does not bring all her caterpillars at one time, but returns to feed the larvae during the growing stage. As soon as the larva spins its cocoon, the mother deserts it. The female of the Philippine *Zethus cyanopterus* is reported as faithfully guarding the larva, even sleeping in the cell while it is small and there is room. From day to day she feeds it upon caterpillars. The mother of *Odynerus tropicales* remains till her eggs hatch, and then brings food for her young.

Fabre and others regard the fastening of the eggs with a string to the roof of the cell on the part of many solitary Vespoids (Eumenes and Odynerus) before bringing in their prey a precautionary measure to prevent the delicate egg from being crushed by the closely packed and sometimes reviving prey. The filament is thought by some to act in keeping the eggs from the occasionally damp walls of the cell. *Bembex mediterraneus* glues its

eggs in an upright position to the floor of the cell and supports it by a cluster of large sand grains. Stizus errans in a similar way glues its eggs to the top of a small, carefully chosen pebble on the floor of the cell.

It may be that the mother wasp's chief interest in her young arises from and is dependent upon "the simple, pleasurable chemical odor or tactile stimuli emanating from the egg and larva." (1) It must be admitted, nevertheless, that the egg and larva have a definite meaning to the mother wasp, and, "so far as the egg is concerned, this seems to be true even in the species that practice mass provisioning." (2)

Parental Care among the Solitary Bees

Consideration for the young of the solitary bees is lacking on the whole with the exception of the careful building and provisioning of the nest. The nests of these creatures are very skillfully prepared for the development of their offspring.

Many of the short-tongued bees make their nests in the ground. The tunnels of these so-called "mining bees" are usually branched, at the end of each branch there being a single cell, which is

1 W. M.Wheeler, Social Life among the Insects, p.67
2 Ibid.

lined with a sort of glazing. Following the provisioning of the cell with nectar and pollen the egg is laid and the cell is at this time closed up. The females of the genus Andrena build their nests, perpendicular shafts with branches leading to cells, in grassy fields. The females of some of the smaller forms dig into the sides of sand banks and cliffs. To this group belongs the genus Halictus.

Like the short-tongued "mining bees", some of the solitary long-tongued bees make their cells in the ground. Some make nests of mud and attach them to stems of plants; others bore holes in wood. Perhaps the leaf-cutter bees furnish the most elaborate kind of cell for the larva. It is characteristic of the genus Megachile to fashion a tunnel in wood that has decayed; then it builds a thimble-shaped tube at the bottom of this. Oblong pieces are cut from leaves and each forms a part of a side and the bottom of the thimble-shaped tube. The genus Osmia prefers the petals of certain flowers with which to line its nest which may be a tunnel in the ground or in a rock. In the little cup which results, pollen and nectar are placed and herein the egg is laid. A circular piece of a leaf, or petal, is pressed down over the top so as to make a tight mass over the cell. Then another cell is placed above. The

small carpenter bee (Ceratina dupla) lives in the dead stems of sumac or the hollow stems of other plants. The several cells which are made are separated by little chips. After finishing the construction of the tunnel, the female waits for the young bees to mature. Each bee waits for the development of the one above it and at last all come out together to join the mother who is waiting to lead them forth into the sunlight.

Parental Care among the Social Insects

Among the social insects we find that there is more evident an active solicitude on the part of the parents for their young, but in most cases the duties of the parents are performed rather early by a worker class which is common among the hive bees and the ants. The queen, or mother of the colony, is occupied with the laying of innumerable eggs.

Parental Care among the Social Wasps

The social wasps make their nests of paper which is manufactured by them from bits of wood chewed up and formed into paste. These nests they place either in the ground or on bushes, trees, or buildings. The females of the genus Polistes build a nest of a single comb which they suspend by a peduncle and leave it without an enclosure. The wasps

of the genus Vespa make several combs of gray paper which they surround by a spherical paper covering. Within these secure situations the eggs are cared for till the time of hatching and then the larvae in turn are zealously attended by the workers who assume the duties of a parent. The young are fed on insects, such as cotton boll-worms and leaf-worms which have been masticated by the adults. Of their homes these wasps are very jealous and resent the slightest trespassing around or near them.

Parental Care among the Social Bees

The life story of the bumble bee is mainly that of the queen. She is the central and dominating figure in the nest, and it is because of her genius and energy that the race continues to exist. She alone survives the winter and independently establishes a colony in which she takes the most prominent position.

The bumble bee queen seeks out a nest, usually the deserted hole of a field mouse, mole, or some other small mammal. This nest may be composed of fine, soft bits of grass or moss; it may consist of leaves that have been woven into a ball with a small opening in the center. Most bumble bee nests are located underground and are reached by a tunnel, sometimes three feet in length. Other species live

in nests on the surface of the ground concealed in the thick grass or beneath ivy. Since these gather material in the vicinity of the nest and comb it with their mandibles and legs, they are often called "carder bees". Occasionally some of the species that live underground are found to make their homes in such places as under boxes, in old birds' nests, in rotten stumps, or on outhouses.

Within the nest the queen spends the greater part of her time, the heat of her body causing the interior of the nest to become entirely dry. After arranging fine and soft material into a heap, she creeps into the center of it and makes a cavity that is snug and warm. This is about an inch wide but only about five-eighths of an inch deep, its entrance at the side being just large enough for the bee to pass in and out.

In the center of the floor the queen forms pellets of pollen moistened with honey and molds them into a mass which she fastens to the floor. On the top of this lump of pollen she builds a circular wall of wax, lays in it her first batch of eggs, and seals it with her jaws as soon as the eggs are laid.

This task being completed, she now sits on the eggs day and night, leaving them only when it is necessary to secure food. To provide for life and

heat during the night or in bad weather, she puts in a store of honey. This she places in a large waxen pot which she builds at the entrance of the nest, so located that she may sip the honey without turning her body, and at the same time guard the entrance from any intruder.

The eggs hatch in about four days, but the larvae can not be seen, for the queen keeps them completely enclosed with wax. The larvae devour their pollen bed, and the queen replenishes the lump. The queen supplies the larvae also with a liquid mixture of honey and pollen which she swallows and churns in the honey-sac. This food is injected through a small hole in the skin of the sac that covers the larvae. Following the feeding process the hole is closed. While small the larvae are fed collectively, but as they grow larger each receives a separate injection. As the larvae grow the queen adds wax to the covering, so that they still remain hidden.

On the eleventh day following hatching the larvae are fully grown and each spins its thin and papery, but very tough, cocoon. These cocoons are made to stand upright side by side, so close together as to appear welded into a compact mass. As the cocoons at the sides are higher than those in

the center, a groove is formed in which the queen sits, her body pressed close to the cocoons and her abdomen stretched to almost twice its ordinary length so as to cover as many cocoons as possible; with her outstretched legs she clasps the cocoons that are on the outside of the mass. In this position she spends most of the time. Sometimes she is almost motionless for half an hour except for the rhythmic expansion and contraction of her abdomen, this affording continual warmth which will bring forth her first brood of workers.

While the larvae spin their cocoons the queen lays more eggs. Further batches of eggs are laid with intervals of two or three days between.

Four or five weeks of hard work cause the queen to become very torn and tattered. She is not as energetic as before and often finds it necessary to stop to rest on the leaf of a tree or on a blade of grass. As soon as the workers are able to assume the responsibility of collecting sufficient honey and pollen to provide for the needs of the family, the queen devotes all her time to laying large numbers of eggs and assisting the workers to incubate and feed the brood.

The activities of the hive bee after taking her nuptial flight are almost entirely concerned

with the laying of eggs; she has no part in the household duties of the hive or in the care of the offspring. The tasks of gathering honey, making the comb, caring for the young, keeping the hive clean, etc., have devolved upon the workers of the hive. The unsexed neuters "take off the shoulders of the fertile caste all the duties of the colony, save only that of reproduction." (1)

The queen bee lays her eggs in waxen cells--which we may term cradles--in the hive. The motherly workers keep pushing their heads into the cells and appear to do something to the eggs, but it is uncertain just what this may be. They keep the temperature favorable for hatching.

The eggs hatch in about three days and immediately the worker-bees, ever on the alert, rush to lavish their care upon the helpless larvae. They keep them warm by uninterrupted incubation; their blood, together with the honey they consume, keeps the hive at an average temperature of ninety-five degrees Fahrenheit. Whenever the outside air is very hot they crowd about the cradles to afford protection like a screen. Then they renew the air by fluttering their widespread, vibrating wings.

1 Julian Huxley, Ants, p.2

As soon as the young hatch, the nurses bring nutriment to them. At first this consists of a generous amount of food which they themselves secrete from their own salivary glands and is known as "royal jelly". On the fourth day the worker larvae are practically weaned and their food is mixed with honey; the drones at this time are completely weaned and feed wholly upon honey and pollen. The queen-larva continues to feed upon "royal jelly". As soon as the larvae cease to eat the workers close the cell with a convex cap.

When the young bees emerge, the workers are at hand to assist them. Shipley describes this procedure in connection with a queen-larva as follows: "Attendant workers wait upon her, arrange her dishevelled hairs, clean her, and offer her honey to eat." (1) Then the workers return to the cell to see that it is in readiness for the time when the queen comes to lay more eggs.

The workers not only supply food for the larvae and keep them warm or cool, as the situation may demand, but protect them as well. Disregarding danger they watch carefully over their drowsy charges. Such attachment to the young is theirs that

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1 Arthur E.Shipley, Studies in Insect Life and Other Essays, p.51

they follow to whatever place the beekeeper takes them. If a "bee-pest" disease breaks out in the hive, they stay as closely by the cradles as before and continue to incubate till they are struck down at their duty.

Parental Care among the Ants

The protective relation as regards the solitary wasps and bees has not reached as yet complete development, due to the fact that these insects are unable to rescue their brood when the nest is disturbed or destroyed. The ants, on the other hand, enjoy more intimate relations with their progeny. Yet, they never build an elaborate earthen, paper, or waxen cell for each larva; unlike the solitary bees and wasps, which never, as a rule, look upon their young, and the social bees and wasps, which center their attention upon the heads and gaping mouths of the young, the "ants have acquired an extensive and uniform experience with all the developmental stages of their species from the egg to the adult." (1)

Ants usually make their dwellings underground. These consist of an irregular series of chambers connected with each other and with the outside world

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1 William M.Wheeler, Ants, p.68

by a likewise irregular series of passages. Of such a sort is the nest that it can be deserted and another constructed in a reasonably short time. There are no fixed and permanent cribs for the young; they are taken from chamber to chamber as it is convenient and in accordance with the dictations of moisture and temperature.

Wheeler speaks of ant societies as societies of females. The males take no part in the activities of the colony; in most species they are present in the nest only for the length of time required for the fertilization of the young queens.

> The males have "no part in building, provisioning, or guarding the nest or even in feeding the workers or the brood. Here the ants resemble certain mythical human societies like the Amazons, but, unlike these, all their activities center in the multiplication and care of the coming young." (1)

Maeterlinck, in describing the habits of *Formica exsectoides* in Pennsylvania, states that "attentions of every kind are lavished on the eggs which have to be constantly and diligently licked, in order to nourish them by endosmosis, and on the larvae and nymphs, which have to be turned and returned and moved from place to place, and exposed at the proper hours, in favorable positions." (2)

The ant seems to be busy with the eggs most of the time from morning till night. In all probability she never leaves them in the same place all the

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1 William M.Wheeler, *Ants*, p.6
2 Maurice Maeterlinck, *The Life of the Ant*, p.89

time. She seems to know where the most suitable spot is for them and proceeds to move them there.

Within the nest the eggs, larvae, and pupae of different sizes are sorted in separate piles, sometimes in the same, sometimes in different chambers of the nest. This habit seems to be very customary with many species of ants, although in the case of the primitive groups (Ponerinae) or in the species that live in small colonies, as in the opulent formicaries of the more highly specialized genera (Myrmica, Aphaenogaster, Formica, Camponotus, etc.) there is not such a clear manifestation of this. A classification of this nature seems to be the result of a need for different degrees of moisture and temperature necessary for the different stages of development. By using artificial nests made of a porous substance, with regulated heat and containing a large colony of Myrmica rubra laevinodis, with an extremely large number of offspring, it has been discovered that on the floor of a very damp chamber there were the larvae of medium and large size; in the less humid chamber adjoining were huge packets of eggs at the bottom of the wall, and fastened above them by hooked hairs were all the larvae that had just been hatched; all the pupae occupied the even larg-

er adjacent chamber. It is possible to see this arrangement in wild colonies only when there has been unusual constancy in the weather for a few days, due to the fact that there occurs a continual shifting about of the young in the nest as the daily changes of moisture and temperature demand, and the bringing of them nearer to the surface during the warm hours of the day, and carrying them down into the nest during the cooler nights.

> "We should try to imagine the enormous amount of work which the care of the larvae inflicts upon the workers: continual regurgitation to these ravenous creatures, perpetual cleansing with the tongue and mandibles, transportation from one corner of the nest to the other every moment, in accordance with the temperature. We shall then understand why it is that so many workers have to invade trees, and hillocks of enemies, either to milk aphids or to look for prey--and we shall excuse the ants for taking some rest!" (1)

Just before the sun appears they are busy with the larvae and nymphs; they carry them hastily to the top of the formicary where they leave them for a time in the heat of the sun. The female larvae are carried by the workers with much difficulty because of their greater weight out through the narrow passageway into the light; there they are placed side by side in the sun together with the workers and males. At the end of a quarter hour

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1 August Forel, The Social World of the Ants, Volume 1, p.453

the workers take them away to place them under shelter from the direct rays of the sun, in compartments, especially for them under a layer of thatch which does not wholly keep out the light. Wheeler, however, holds that rarely, if ever, do ants bring the brood to the surface unless when compelled to move to another nest or unless they belong to a species like the slave-makers which kidnap the young of other ants. Upon occasions, however, when the weather is warm, the ants' young may be taken to the surface after night has fallen. In the dry deserts of Western Texas "Ischonyrmex cockerelli brings its larvae and pupae out onto the large craters of the nest about 9 P.M. and carries them leisurely to and fro, more as human nurses wheel their charges about the city parks in the cool of the evening." (1)

In addition to keeping the larvae in a suitable environment, the ants aid their young while undergoing their transformation by embedding them in the earth till their cocoons are woven and at the end pull the hatching callows from their places of confinement. Even after the transformation of the larvae into nymphs, with or without a cocoon, the workers still lavish upon them every care by cleansing them and transporting them with regard to changing the temperature; feeding alone is dis-

1 William M.Wheeler, Ants, p.69

continued.

The larvae about to make a cocoon are furnished with fragments of earth to which they attach their threads. Later on the cocoons are cleaned and at last the shell is skillfully cut with the teeth of their mandibles before hatching takes place. Sometimes the workers assist the callow in issuing forth from the skin and in spreading its wings.

Different species have been observed to use different methods of nourishing their brood. Many, as is true of most of the Camponotinae, Dolichoderinae, and Myrmicinae, supply their larvae with regurgitated liquids; the Ponerinae, on the other hand, many Myrmicinae, and probably the Dorylinae, feed them with portions of the same kind of food that they furnish for their own use. For example, carnivorous species supply their larvae with pieces of insects, while the harvesting ants, Pogonomyrmex, and some species of Pheidole furnish fragments of seeds. Without doubt, the species Aphaenogaster, Lasius, and Pheidole feed both regurgitated and solid food to their brood. The larvae of the fungus-growing Attii of Tropical America feast upon wisps of fungus-hyphae. The larvae of the East Indian Camponotus quadriceps feed directly on the

pith of the plants in which the insects nest.

Wheeler has made some interesting observations in connection with the manner in which the workers feed the young. Odontomachus clarus, in an artificial nest, placed the larvae "on their broad backs, with their heads and necks folded over to serve as a table or trough on which the workers placed the food. One particular evening several house-flies which had been placed in the nest were immediately shorn of their legs, then decapitated, and finally their thoraces and abdomens cut into smaller pieces and distributed among the larvae." (1)

One received a fly's head, which it twirled around in an amusing fashion, the while devouring the brain through an opening made in the head region. Likewise the other larvae were served their portions of the viands.

Another evening a small Homopterous insect was placed in the Odontomachus nest.

"One of the ants (A) snapped at it, disabled and then left it. A few minutes later it was picked up by another ant (B) which carried it into the chamber containing the larvae and pupae. Thereupon a third ant (C) took hold of it and began to tug at it with B till it was torn open, but not into pieces. B then placed it on the flat ventral surface of a medium-sized larva, which began to feed at once, moving the Homopteron around with its jaws. After four minutes had elapsed, another ant (D) that had been standing nearby, apparently much interested in the feeding, suddenly tore the morsel away and placed it on a small larva. This larva was permitted to feed ten minutes, closely watched during all this time by ant D and another (E) which had come up in the meantime. Then ant D tried to tear the morsel away from the small larva, but apparently unable to

1 William M.Wheeler, Ants, p.236

do so, took the larva with the morsel and dumped both on the ventral surface of a large larva. This creature seized the Homopteron and forced the small larva to release its hold and to drop to the ground. The large larva fed for fully twenty minutes, closely watched by the ant D and two others (E) and (F). All of these ants tried at different times to wrench the morsel away from the larva, but failed. Suddenly a small ant (C) rushed up, tore it away and ran off with it...." (1)

It would appear as one witnesses such operations as this that the workers intend that each of the offspring receive a fitting proportion of the food supplied for the colony.

We are prone to emphasize the limitations of the ant queens, but we should, perhaps, consider the sacrifices which they have had to experience in their younger days. Indeed, it is no ordinary undertaking to rear a family of even very small children without eating anything except partaking of a diet which comes from one's own tissues. This is the predicament of a young queen which leaves the nest of her parent to establish a new colony. As a result of such drastic demands upon them a very small number of the many thousands of ant queens endure till the time that they become mothers.

Remarkable is the protection which is afforded the colony by the workers. Ants resent the slight-

1 William M.Wheeler, Ants, p.236

est intrusion upon their nest and if mere withdrawing into their nests does not serve to shield them from danger, and their home is destroyed, they make haste to rescue their eggs and offspring. In spite of danger they will scurry back and forth carrying now an egg, now a larva till all these have been removed to a place of security and new chambers have been fashioned for them. Without exaggeration ants may be said to display a solicitude for their young by way of care and protection that is comparable to that existing among the higher vertebrates.

Chapter Five

Parental Care among the Amphibians

Parental Care among Amphibians in General

To the ordinary observer who watches the jelly-like masses of frogs' eggs which may be seen in ponds and by roadsides in the early spring and to him who follows in a casual way the development of the tadpole after its emergence from the egg there would appear to exist no attention afforded in this group on the part of the parent, or parents; there is evident for the most part no protecting and feeding of the offspring.

As a matter of fact Amphibians are creatures of queer breeding habits. Thomson speaks of them as either "quaint or careless parents". (1) In many cases there are primitive instincts for guarding, or at least remaining close by the eggs during the early stages of development, the male assuming the responsibilities of nurture. In most species, however, as far as our ordinary frogs and toads are concerned, there results an abandonment of the eggs immediately after they have been deposited. Some types of this order attend to their eggs, and yet

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1 J.Arthur Thomson, The Study of Animal Life, p.110

are utterly indifferent to their young, such behavior being probably due to the fact that while the young are aquatic, the parents are terrestrial, or to the fact that these animals are endowed with low mentality.

Parental Care among the Salamanders

As we center our attention upon the salamanders we realize the lack of the parental instinct except in so far as the females appear to deposit their eggs in a proper environment, and in a few cases to incubate them. Ichthyopis glutinosa may be taken as an example of this group.

> "The female digs a hole close to the surface in moist ground near running water, and there lays about two dozen eggs. The egg-strings become glued together, entangled in a bunch, and the female coils herself round the bunch and remains in that position, probably to protect the eggs from other burrowing creatures, as blind snakes and certain limbless lizards, with which the ground literally swarms." (1)

The female Desmognathous, one of the subfamily Desmognathinae of the Salamandridae, lays its eggs in two long strings which become wound round her body like a rosary. She then seeks seclusion in a hollow in the mud, or beneath a stone or other suitable place, there to await the appearance of her offspring.

Autodax lugubris, a species belonging to the

1 Hans Gadow, Amphibia and Reptiles, pp.90-91

subfamily Desmognathinae of the Salamandridae, deposits its eggs in a hollow underground, and seems to remain curled around them until they are hatched, a matter of two or three weeks' time.

The nests of the mud puppy are just slight excavations beneath flat stones, boards, or logs with the eggs attached to the lower surface of these objects. In swift-flowing streams the entrance is protected by being placed on the downstream side. None of the males are found on the spawning grounds during the egg-laying season. The females after depositing their eggs, one hundred or more, fasten them securely to the object of their shelter and remain with them not only till the young have hatched, but in many cases till they have left the nest.

The male of the hellvender makes a basin-shaped cavity with its entrance on the downstream side into which he drives the female. As soon as spawning is over he drives the female away and he himself carefully guards the eggs from other males, spent females, mud puppies, or other enemies.

Parental Care among the Batrachians

Location of the Nest

Many species of frogs, particularly those inhabiting the tropics, have devised a method where-

by they may build their nests and care for their larvae in a manner "little less different in style and scarcely less ingenious than that employed by the birds." (1) The tree frog, Hyla faber, of Southern Brazil, and Leptodactylus ocellatus, the common pond frog of the Argentine, display rather outstanding ability in constructing craters of mud. The animal digs up with its feet mud from the bottom of the pond; with this material it proceeds to make little craters, whose rims reach higher than the water level. Hyla resenifictrix lines a cavity of a hollow tree with a layer of beeswax, making the hollow through this treatment capable of holding water and of keeping a moist condition. Some of the Brazilian tree frogs have been found folding up leaves and gumming them together to serve as a nest. Budgett, during his travels in the region of the Paraguayan Chaco, observed a similar nest of Phyllomedusa hypochondrialis; this nest, containing eggs, was suspended over the water. Within the next three weeks he witnessed about twenty such leaves, always not more than two feet from the water. In regard to the resting habits of Leptodactylus ocellatus, Budgett relates

1 Thomas Barbour, Reptiles and Amphibians, p.78

the following:

> "They [native boys] pointed out to me holes in the ground beneath tree trunks, of the size of a cricket ball and lined with a froth containing white eggs and also tailed larvae. To whatever frog these nests belonged it is certain that they were a most ingenious contrivance for collecting water and for keeping the eggs and larvae at least moist, between the storms of the wet season. They were always found within the forest belt and lay on the highest elevations." (1)

Depositing of the Eggs

Many interesting observations have been brought to our attention in connection with the breeding habits of these clumsy but on the whole fascinating individuals, especially by Mary C. Dickerson in the "Frog Book" and by Gadow in "Amphibia and Reptiles". We may refer also to Barbour's "Reptiles and Amphibians". Through such sources we find that there are some species of frogs, as Nototrema and Notodelphys, that carry their eggs in pouches on their backs or in sacs within the throat. The tree frog, *Hyla faber*, and *Leptodactylous ocellatus*, deposit their eggs within the haven of craters of mud. *Hyla resenifictrix* places its eggs in the cavity of a hollow tree which it has lined with resin so that it holds the moisture necessary for their development. Within leaves ingeniously folded are enveloped in a mass

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1 John S.Budgett, *Batrachians of the Paraguayan Chaco*, p.63

of froth the eggs of the Brazilian tree frogs. Gadow mentions in particular *Hylodes martinicensis*, the female of which envelops its eggs in a foamy mass and glues them onto a broad leaf hidden in the axillae of Iridaceous plants. Budgett watched a male and female of *Phylomedusa hypochondrialis* climb onto the edges of a leaf which they held near the top with their hind legs in such a fashion as to form a tunnel. The female filled the tunnel with eggs which the male fertilized. As the two moved up the leaf they brought the edges of it together with their hind feet and the jelly on the eggs sealed the enclosure. In Southern Chile the male of a tiny cricket-like frog, *Rhinoderma darwini*, takes the fertilized eggs and crams them into his singing pouch which has become enlarged at the singing season, or at the time of mating.

The male of the "obstetrical toad" of Europe carries the string of eggs coiled about its legs until the young are ready to hatch. It is interesting to note Gadow's account of *Anura obstetri*cans, the Mid-wife Toad.

> "During the expulsion of the eggs the male.... pushes first one hind limb and then the other through the convoluted mass of eggs, which have the appearance of being wound round the hind legs in a figure of eight. Then the sexes separate and the male withdraws with its precious load into its

hole." (1)

Undoubtedly most interesting in this respect is the Surinam toad. As the female protrudes her oviduct, it is introverted and the male passes it beneath its body in order to fertilize the eggs; at this point the male pushes out the fertilized eggs into pockets upon the female's back and the pockets are closed by lids while incubation of a sort takes place. It is said that fifty eggs are thus placed upon the female's back at one time.

Incubation of the Eggs

True incubation of the eggs by the batrachians is negligible. The male of the "obstetrical toad to be sure carries its string of eggs wound about its legs till the time of hatching. Nototrema and Notodelphys carry their eggs till the time of hatching within a dorsal pouch, an arrangement dimly suggestive of the pouch of kangaroos and other marsupials." (2) Rhinoderma darwini allows the fertilized eggs to remain in its mouth till such a time as the young hop from its mouth as fully developed froglets; as Thomson puts it, this is a case of "turning a resonating sac in a most matter-of-fact way into a cradle." (3) Hylambates brevirostus of equatorial Africa gathers its eggs into its mouth and in this environment the young are hatched. The male of the Mid-wife Toad, its legs covered with eggs,

1 Hans Gadow, Amphibia and Reptiles, p.159
2 J.Arthur Thomson, The Study of Animal Life, p.111
3 Ibid.

withdraws into a hole, which it leaves during the nights that follow in its search for food and takes the opportunity to moisten its eggs with the dew, occasionally even emersing them in the water. At the end of about three weeks he makes his way to the nearest water where the larvae burst forth from their gelatinous covering.

Care of the Young

With reference to *Hyla faber*, Gadow made a discovery which helps to show in rather a clear way the care bestowed by some frogs upon their young. The female of *Hyla faber* made a crater-like nest and during one of the following nights laid her eggs; the latter hatched some four or five days afterwards, the parents the while remaining in the vicinity of the nursery. *Hyla resenifictrix*, to which reference has already been made, rears its young in a resin-lined cavity in a hollow tree. The female of *Hylodes martinicensis* seems to stay near by the broad leaf, within which is her foamy mass of eggs, and later the young. The Surinam toad not only incubates its eggs in the little pockets on its back, but also carries its young about in the same location.

Chapter Six

Parental Care among the Reptiles

Degrees of Parental Care among the Reptiles

With few exceptions the eggs of reptiles are hatched outside the body; in only a few cases are they retained until the young are born.

> "Brood care is almost completely confined to a choice of the place in which the eggs are to be laid, and the formation of a nest or burrow to contain them. The females alone perform this duty, and, although in certain cases the mothers exercise some guardianship over the young after birth or hatching, the males take no interest in them." (1)

There are evident, however, in the different kinds of reptiles all stages in the process whereby the family is reduced in number, and better means of protection are afforded the eggs, larvae, and the young. Parental care exists instead of a state of prolificness. We may witness nothing educational in the true sense, but the instincts of parents and young become changed by the association brought about by family life.

Parental Care among the Turtles

It seems truly remarkable that the female turtle, or tortoise, is so solicitous for the welfare of her offspring. She deposits her eggs in a

1 P.Chalmers Mitchell, The Childhood of Animals, p.143

hole in the ground and afterwards, not only covers them but proceeds with the greatest care to remove all traces of their existence. The common European pond tortoise moistens the hard bare ground from her bladder and anal water sacs, bores a hole with her tail and then enlarges it with her hind feet to the depth of several inches. In this hole she places her eggs, after which she firmly presses down the earth over them. Nothing but an accident will cause their discovery. The female loggerhead turtle concerns herself only with making a hole in the sand above the tide mark, laying the eggs therein, covering them up and deserting them.

The edible turtle may be considered wise in this respect that before venturing from the water she scans the shore for any foes that may be present. If all is well, she goes to the shore to choose a breeding place in a sheltered sandy spot beyond the tide level. When she has laid her eggs in a properly prepared nest, she not only covers them up and carefully smoothes the surface, but also makes her return to the sea by a winding route. Not very different from these are the customs of the box turtle, the Greek tortoise, and the soft-shelled turtle, with an exception in the case of the last mentioned creature in that it burrows into

a bank and turns around with its snout sticking out as it lays its eggs, instead of digging a hole in the ground in which to place its eggs.

Parental Care among the Alligators

Somewhat more concern for their offspring is displayed by some of the alligators and crocodiles which prepare nesting mounds as receptacles for their eggs. The Florida alligator collects reeds and grass, and flattens them down. This act it follows by laying its eggs, then covering them with more reeds and grass. The male appears to leave the vicinity, but the female remains and has the reputation of even attacking persons who may disturb its sanctuary. Just prior to the time of hatching it is reported that the mother hears the squeaks of her young and proceeds to open the mound and release the little creatures. *Crocodilus niloticus* of Madagascar lays her eggs at night in a hollow varying from eighteen inches to two feet in depth. The hole is then entirely filled up and no traces are left behind. It would seem on the whole ridiculous for the mother to sleep upon the nest which eventually leads to its being discovered. One may note with interest the care displayed by this creature in choosing a spot for the position of its nest, a position of such a character that moisture

from below can not reach it, since the presence of dampness even though small in amount causes the eggs to turn bad.

> "Voeltzhow," Gadow states, "feels certain that the mother after a sojourn for food returns to the nest at the proper time in order to dig the young ones out and to conduct them to the water." (1)

To strengthen his suspicions he had a crocodile's nest surrounded by a fence, which was replaced after each of the parent's visits by a stronger one. One day, following the hatching of the young, the nest was found filled up with sand, while the shells and one dead little fellow lay at the bottom. The mother had failed to reach the nest by digging a deep ditch below the fence; she had succeeded, however, in receiving and conducting her offspring away. Under ordinary circumstances the mother is probably warned by the hiccough-like sound emitted by the young still inside the unbroken shell, so that she comes to the rescue and removes the eggs from the groove. With reference to this particular species of crocodile it has been found that the young after being escorted to the water are guarded by the mother. Always among crocodiles there occurs the careful selection and preparation of the nest. Frequently eggs and young as

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1 Hans Gadow, Amphibia and Reptiles, p.463

well are protected by the mother.

Parental Care among the Snakes

Maternal care in most of the snakes is limited to the finding of a place in which to lay their eggs. A few go further in that they incubate the eggs for days and weeks before the young snakes break through the leathery shell. The gunnel on the shore coils round the egg mass. The boa and the python, as has already been noted, coil about their eggs and thus incubate them.

These reptiles, however, are approaching the condition where they will protect their eggs by retaining them inside their bodies till the time of hatching. A number of them have already become viviparous; such is the case with respect to the smooth snake, the common adder, most of the burrowing snakes, and many of the sea snakes.

The sudden disappearance on the part of the adder when anyone approaches has led to the belief that this snake stays with its young and protects them. Sea snakes are said to protect their young after they hatch.

Chapter Seven

Parental Care among the Fishes

Parental Care among Fishes in General

Not a few of the fishes that lay their eggs by hundreds in the water pay no further attention to them. And yet, among these cold-blooded animals one may find rather outstanding examples of parental care. It may be said that among these vertebrates

> "the attention which the different species give to their eggs and young ranges from almost complete indifference to nest building and post natal solicitude. Even the many species, both from salt and fresh water, that build no nests and cast their eggs loose, have more or less definite spawning grounds, certain supposedly favorable areas to which they go annually to reproduce their kind." (1)

The Making of Nests and the Depositing of Eggs

Among those numerous marine forms whose eggs are pelagic parental care is at an end as soon as the eggs are deposited. There is evidence, however, that in these instances the eggs are laid in a locality of such a nature that conditions will be favorable for hatching and in a place where food is available for the newly hatched young. Some marine species also, taking for example the salmon, and nearly all the fresh-water species lay eggs that are heavier than the water, or demersal eggs, which

1 Samuel F. Hildebrand, Fishes, Part 1, Volume 8 of the Smithsonian Scientific Series, p.107

immediately sink and are left to chance. Yet many of these fishes show an amount of concern in depositing their eggs by scooping out holes and covering their eggs with sand or stones.

Several of the fresh-water species build some sort of nest. In the case of the sunfish family of our fresh waters, a spot on the solid bottom of the stream is "swept clean and bare probably by the fanning with the lower fins of one of the parent fish, a duty which almost always falls to the male." (1) The female salmon may be seen ploughing a furrow in a gravelly bed, and there laying her eggs, all the while taking care lest she disturb the places where others have already spawned. In the American bowfin (Amia calva) nest-building reveals a great deal of care on the part of the male parent, which selects small areas under the water where there are no growing plants, and spots which are concealed.

> "By movements of the body and fins and perhaps by biting he removes some of the plants and the bottom ooze so as to leave exposed the fibrous roots or the sand, gravel, and other subjacent material." (2)

The common toadfish of the American side of the North Atlantic makes use of mollusc shells, old shoes, iron pipes or tubes, and any similar contain-

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1 Samuel F. Hildebrand, Fishes, Part 1, Volume 8 of the Smithsonian Scientific Series, p.108

2 Ibid. p.109

er in which to deposit its sizeable eggs. To the sides of these objects the eggs adhere and they are guarded by the parent fish. Likewise the gobies and blennies appropriate mollusc shells as nests.

Several species of fish, as the African species of the Characinidae, make a nest of air bubbles which are blown from the mouth and inclosed and held together by a secretion. A large sucker-like organ on the front of the head makes it possible for the larvae to hang for a time from the surface of the water. Thomson speaks of the male Chinese macropod as making a frothy nest of air and mucus, in which he places the eggs.

Gymnarchus niloticus of Africa deposits its eggs in a large floating nest which measures about two feet in length and one in width with an inside measurement of about a foot by six inches. This nest is located in the thick grasses of the swamp in three to four feet of water. On three sides the nest is above the surface of the water, while the fourth side, somewhat lower, is about two inches below the surface. Polypterus, when the Nile overflows, enters the swamps and chooses a spot where there is very little opening in the grass, the heads of which she makes into a sort of raft and thereupon lays her eggs in rows.

Thus we may find several types of nest building, or would be nest building, among the fishes, bringing us to the realization of an advancement on the part of some species over others in providing for the safety of their eggs which become fewer in number and thus must be guarded in order to insure the hatching of a sufficient number of young that may function in the propagation of the species.

Incubation of the Eggs

Authorities appear to agree that the female is the carefree parent as soon as the eggs are laid. It is the male which assumes the responsibility for the safety of the eggs and the young. It falls to his lot even to protect them from the females who laid them, as they are their worst enemies.

> Hildebrand states that it is "quite the usual custom for many fishes to take care of the eggs, and sometimes they watch over the young. The females have very little reputation as mothers to boast of, with two or three exceptions, one of which occurs among some catfishes, the aspredinids. In some cases, the female apparently hovers over the eggs after they are laid so that they may adhere to a peculiar soft spongy structure on the lower side of the body. She then carries them until they hatch." (1)

Another exception is that of the pipefishes, the female of which is furnished with a pouch for retaining and incubating the eggs.

1 Samuel F.Hildebrand, Fishes, Part 1, Volume 8 of the Smithsonian Scientific Series, pp.110-111

"The common British butter fish (Pholis gunnellus) coils its body round the mass of eggs, both male and female relieving one another in this task, ..." (1) As soon as the eggs of the sunfish have been laid, "in the nest the male stands guard, fanning the eggs with his fins, probably partly for the purpose of keeping them free of sediment and partly for proper aeration." (2) The common pipefishes (Syngnathedae) and the sea horses (Hippocampus) have pouches in which the eggs are incubated and from which the young are allowed to escape as soon as they are hatched. Fishes that reduce the number of their family still further protect it by carrying the eggs and young larvae about with them. Perhaps one of the strangest habits is that of the male fish, for example Arius, of hatching the eggs in its mouth. It may seem somewhat humorous "to see the male sea-horse swelling up as the eggs which he has stowed away in an external pocket hatch and mature," (3) till finally there emerge a number of little creatures, almost transparent and in shape resembling marks of interrogation. The pipefish incubates its eggs in a similar manner.

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1 Samuel F.Hildebrand, Fishes, Part 1, Volume 8, of the Smithsonian Scientific Series, pp.110-111

2 Ibid. p.108

3 J.Arthur Thomson, The Study of Animal Life, p.110

Care of the Young

Courage and devotion stand forth among several species of fish which during the incubation period guard the eggs constantly. The lungfish never leaves his post save to drive away an intruder so that when the larvae hatch he is worn out from exhaustion and hunger. Thus, too, the stickleback stays close by till the time of hatching. The lumpsucker has been known even to draw blood by biting at the hand of a too inquisitive observer, but his devotion endures only till the young hatch out. Many instances may be quoted to reveal this phase of parental care, but in most cases this is the maximum stage which is reached by the care and devotion displayed by fishes toward their young.

The toadfish, however, goes a step further. The male not only fiercely and zealously watches over the eggs that have been deposited in an empty shell or a tin can but also later on carefully keeps the young within certain bounds until they are ready to set forth alone. He seems happy to afford them shelter beneath his pectoral fin. The male of the bowfin of the Great Lakes is ever alert. When there is cause for alarm, he exhibits the greatest concern for his charges. Sometimes he backs into a reed-screened pool to hide; again he slips away drawing

the swarm after him. In case of urgent need he will face even a formidable enemy. And so, for several weeks, and occasionally longer, the young remain under his care and guardianship. Perhaps there are so few cases of parental care among the fishes that its consideration should be given no prominence, yet "it gives us a glimpse of possibilities in the nature of fishes that we should hardly have expected from a study of their everyday life." (1)

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1 J.Arthur Thomson, The Ways of Reptiles, The New Natural History, Volume 2, p.537

Chapter Eight

Parental Care among the Birds

Suggestions Explaining the Attitude of Birds toward Their Young

It may be stated without exaggeration that birds in general present a unique picture of the devotion bestowed by parents upon their offspring. Theirs is the instinct, parental and fostering, so deeply rooted that even during the process of incubation there is evident such a tenacity of purpose that in spite of wounds the parent bird has been observed to cast herself upon the nest in a last effort to guard and protect her own. We may refer at this point to the grebe which instead of deserting its nest when shot lays itself on its eggs and there expires.

What has been the origin of such an instinct? It is possible that the incubation instinct arose after the birds had carried and laid the eggs, which would have rotted had not some birds just happened to cuddle them and so saved them from extinction. Holmes would consider such an origin clearly impossible and refers to the reptiles, the cold-blooded ancestors of the birds. He holds that the instinct to incubate resulted from an instinct

to remain where the eggs were left for the purpose of affording them protection. Heat was necessary to make the eggs develop more rapidly.

> "The advantage thus accrued [from heat] to the species may have caused the protecting instinct to develop further into a true instinct for incubation and with the development of warm-bloodedness, which went on during the evolution of birds from reptiles, the supplying of artificial heat, at first only as a means of hastening development, became an indispensable condition of development." (1)

Dependence upon artificial heat and the development of the instinct for incubation must have evolved side by side.

Shall one hold that the brooding bird sits mechanically and in so doing infer that she does not have an "appreciative awareness" (2) that the eggs are the products of her own body?

> Thomson believes that "it is certain that incubation has become a part of instinctive routine, engaged in because of inborn nervous prearrangements which operate when appropriate stimuli pull the trigger; but it is uncertain to what extent the instinctive performance is associated with the activation of higher nerve centers, which may imply some degree of appreciative awareness to what extent the bird may have acted intelligently or controlledly in ancient days when a new departure in instinctive routine was tested and either approved or rejected." (3)

It is difficult to explain to advantage a circumstance in which pigeons have been known to appear

1 S.J.Holmes, Studies in Animal Behavior, p.42
2 J.Arthur Thomson, The Biology of Birds, p.288-289
3 Ibid.

totally unaware that eggs which have been removed from the nest and placed nearby belonged to them, and have made no attempt to recover them. Foolishly, it would seem, birds, especially the common fowl, will continue to sit in the absence of eggs. It is all too evident that in such cases "the enregistration of certain chains of behavior may be so thoroughgoing that it approaches mechanization." (1) All too prone are we to ridicule the hen whose eggs have failed to hatch at the close of the period of incubation, and yet she continues to sit upon them with as much interest as before. The same attitude has been noticed in the case of tumbler pigeons. The number of days required for the young to hatch out is known to be variable. Instead of drawing the line too closely, Nature allows for the extreme cases.

Location of the Nest

The nest is an important object for consideration as forming one of the links in the evolution of parental care, since it serves not only in concealing and sheltering the eggs, the young, and the brooding bird but serves as well in making brooding an easier and more effective procedure.

1 J.Arthur Thomson, The Biology of Birds, p.289

Previous to the period of incubation the parent birds exhibit various degrees of interest in arranging for the hatching of the young and as a result, there may be noted several types of nests among the different species, and sometimes within the species, each type being suitable to the needs of the bird.

As one traces the course of development of parental care among the birds now in existence there appears a wide gap between the primitive ways and those of the present time. In the less evolved species to which belong the different kinds of water-birds there is outstanding evidence of decidedly primitive attempts at nest making. In many cases the egg is laid on the ground where it is incubated. The tern is satisfied with scraping on the sand or a shingle, as is also the case with divers, thick-knees, and sand-grouse. On the ledge of a rock may be seen the long egg of the razorbills and guillemots; while the stone curlew and night-jar arrange no sort of nest. The amusing Antarctic penguins because of lack of better material build a mound of pebbles. What objects of interest must the king penguins be, and the emperor penguin, too, which even less fortunate than the Antarctic penguin when it comes to a supply of nest material, sits

with its eggs on the backs of its feet and over it covers a loose fold of leathery skin which hangs down from the bird's abdomen. It incubates while standing and shuffles along awkwardly as it moves its burden. In this peculiar position the egg is hatched. The large species of Antarctic petrels nest on the ground; the smaller species nest in the ground. Such an occurrence may be attributed to the fact that the larger are more able than the smaller to protect their homes not only against each other but also against the robber gulls.

The next picture reveals the gulls, sandpipers, and plovers which deposit their eggs in hollows in the ground, adding a sort of breastwork of stems and leaves as incubation proceeds. Ducks, too, proceed in a somewhat similar way, with the addition of down for comfort. The whip-poor-will feels secure in placing its eggs in depressions which are numerous among the dead leaves throughout the woods. The ringed-plover makes use of a shingle, and where the uplands are grassy it continues to line its nest with small stones--its former habits of living, even though they have become irrelevant, appearing as instinctive promptings.

Mention must be made of those birds which follow the custom of many reptiles, such as the croco-

diles. The brush-turkeys seem satisfied to "scratch together a loose heap of earth and rubbish, lay their eggs in the midst of it, cover them, and leave them to hatch by the even but not exceeding warmth of the mass." (1) Not so different from this is the nest of the ibis in which the young hatch and either dig their way out or are aided by the male birds who care for the incubator. The female ostrich and the black-backed courser bury their eggs in the sand, leaving them during the day. The male incubates them during the night. Somewhat similar is the habit of the grebes and rails, which during absence from their nests leave them covered with damp weeds, and the ducks which cover their nests with down. The former custom probably dates back to the time when it was necessary to hatch eggs by means of the heat produced by the fermenting of the green leaves. Some of the mound birds have been observed likewise to bury their eggs, but others cover them with a hot-bed of dead leaves, and leave as soon as they cease laying their clutch. The quill-feathers of the chicks, however, are sometimes so long that they can fly at birth, so everything goes well.

1 Glover M. Allen, Birds and Their Attributes, p.192

Shall we consider as unfortunate those birds which, because of their size or habits, find it difficult to withdraw from view during the period of incubation? In this group may be included the ostriches, albatrosses, cranes, and swans, which are ordinarily aggressive so that they may guard their nest from attack. Generally speaking, these birds either make no nest at all, or, at the most, only arrange a very simple sort of nest construction composed of a few feathers and bits of rubbish. For example, ostriches dig holes in the ground--several females taking part--in which they lay their eggs and cover them up. The emus dig a shallow hole in the ground, but do not cover their eggs. The cassowary carelessly prepares a pile of leaves and mold upon which to lay her eggs. The apterix lays her one huge egg in hiding among the fern roots.

It seems wholly probable that in the next stage a desire to become concealed from view while incubating replaces the former notion of sitting in an exposed area and the bird searches out some cavity, which may be a hollow tree or a deserted burrow in the ground. Burrowing is characteristic of the "members of many groups, such as the burrowing Owl of America, the Sand-Martin, of some of the Swallows,

the Minera, a South American passerine bird, some Penguins and the Puffins amongst the Auks; but it is especially characteristic of birds which sally forth for their prey from a perch and return to it, using their feet but little, such as Kingfishers, Bee-eaters, Todies, and Motmots, and of the Petrels among the sea birds. Bee-eaters are most inveterate burrowers, forming regular warrens and even sometimes burrowing into level ground as Petrels do, ..." (1)

The woodpecker is noted for its home devised by making a hole in a tree. The nuthatch follows a line of less resistance and takes possession of one that has already been made. The sand-martin, as the name suggests, utilizes a hole or tunnel as a place of security for its eggs and places within it, probably to afford comfort, roots and feathers. Outstanding among the birds that make use of holes are the hornbills of the tropics which have a style all their own in building a nest in a hole in a tree which affords remarkable protection. The male actually plasters up the entrance to the nest cavity in a hollow tree, the only opening being a hole through which he may insert his beak when feeding his mate. It is possible to see while riding through the country numberless holes in sand banks, suggesting that a volley of much enlarged shot has been fired in that direction. These are nothing other than the entrances to the homes of the cliff-

1 Frank Finn, Bird Behavior, p.171

dwelling swallows.

Herrick specially emphasizes the idea that a first purpose in making a nest is with the desire to build a rampart about the eggs. Allen considers the primitive incubator as perhaps an original factor, and the nesting habits as being largely responsible for the development of the more complex structures. The higher song birds prepare a nest with care in which they may hatch their young.

We proceed from actual nests, or apologies for such, in one direction to the earth-mounds of the flamingoes, and in another to the rough, platform nests of the wood pigeon, many times so slight that the eggs may be viewed from below. There follow the constructions so elaborately made by rooks and crows. Magpies exhibit an improvement upon these in the fence of thorny sticks, which shows defense, and the bittern and heron, too, with the lack of bedding within.

Among the types of solidly built nests is that of the swallow--shaped like a half saucer, composed of mud held together with straws, affording comfort inside because of a lining of feathers and fine grasses. The house-martin goes a step beyond this with its mud nest in the shape of half a deep cup closed with the exception of the doorway at the top

or over at one side; its lining consists of feathers, found in the air, and pieces of straw.

> "The nest of the South American oven-bird is nearly as big as a football and weighs eight to nine pounds; it is made of mud mixed with a few sticks and straws, and shows an elaboration in being divided into two rooms, an anteroom and an egg-room. It is a big, massive nest, but it is built pellet by pellet by a bird with a tiny bill." (1)

Then there is the feltwork type of nest of such birds as the chaffinch and goldfinch. Constructed of a foundation of interwoven "fibers they may be lined with hair or feathers, and disguised externally with moss and lichens and spider's web. They are open in these two cases, domed in the wren and bottle titmouse, slung like a hammock in the goldcrest and oriole, suspended by a string in certain grosbeaks and hummingbirds. These nests have two good qualities; they must be very comfortable and they are well camouflaged. In the nest of the long-tailed-tit is the feltwork of lichens, moss, wool, and spiders' webs and a quilt-like lining of small feathers,...." (2) It is an elongated oval with a small doorway in the upper part of one side.

The nest of the ruby-throated humming bird is saddled to a high branch and so covered with lichens as to make it resemble an "excrescence on the branch." (3) The Baltimore oriole fastens its nest to the very end of an overhanging bough and to deceive its winged enemies builds it to resemble the nest of a hornet. When the nest is built, consideration is taken of the comfort as well as of the safety of the

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1 J.Arthur Thomson, The Biology of Birds, p.298
2 Ibid.
3 Arthur R.Dugmore, Bird Homes, p.12

young, the lower part being compactly and strongly made; the walls, however, are loosely woven that there may be a free circulation of air.

And thus we may continue to consider the types of nests, noting marked variations in many instances, for there is a degree of plasticity in the species, realizing very little with how much concern the parent birds for the most part endeavor to prepare by way of a nest the environment most conducive to the comfort and well-being of their offspring. Even though this habit on the part of the bird may be judged entirely as an instinctive act, because of the urge to build that has continued through the generations, one must attribute to the bird more than a moderate amount of awareness that it is preparing a suitable location not only for its own safety and that of the eggs during the brooding period, but also that it is providing for a comfortable abode for its young later on, till such a time as they are able to protect themselves and independently secure their food.

Incubation of the Eggs

After an egg has been laid, both parents fuss about in the neighborhood of the nest and keep careful watch over the cradled treasure. When the winds blow cold and the weather is damp or wet, the mother,

sometimes the father, furnishes warmth for the eggs, yet does not really sit in earnest; with assiduity does she sit only after the usual number of eggs has been laid. From the time that the first egg is deposited the inclination to sit increases in its intensity in several ways. With the "commencement of laying the temperature of the bird's blood rises, and this produces a restless, feverish state of excitement, she utters peculiar notes and tones, eats but little, and casts many feathers from certain parts of the body, leaving bare places which tend to facilitate the transmission of heat to the eggs." (1) The plucking of feathers from the breast is not uncommon in such birds as the eider-duck and ducks in general. In the case of the grebe, which swallows its feathers, there seems to be no special advantage in such an act. There are evident great bare patches on the breast and belly, reddened and the skin greatly thickened. The plovers, guillemots, razorbills, and little auk develop such spots. Only the females bear witness of this condition, excepting in those instances where we discover that the male also aids in incubating. Some birds, such as the pigeons, divers, and cormorants are not known to have these spots, and only the male of the queer phalaropes.

The female principally assumes the role of in-

1 Dr.Alfred E.Brehm, Bird Life, p.323

cubating the eggs; the male rarely takes part in business so burdensome and tedious. It becomes his duty to furnish his mate with food and honor her with his presence. He helps to lighten the weary hours with his singing, or perhaps with performing some feat on the wing or paying some other pretty attention. During the hours of the night the male lingers near the nest. To participate further he seems to consider as unnecessary. There are, however, extra-fatherly males in most of the "ratite" or primitive flightless birds--the emu, cassowaries, rheas, kiwis, or apterixes, but not the true ostriches. In the London Zoo the mother rhea had to be driven away from devouring the food that was furnished her offspring, while the male scarcely touched it. It is interesting to note that the male rhea assumes the usual role of the female, as he not only sits on the eggs but brings up the little family as well, while the female never concerns herself with either duty. It is evident that in some cases the males and females share alike in this task. Woodpeckers, pigeons, plovers, peewits, the curlews, phalaropes, waterhens, gulls, nightingales, sedge warblers, and some others share in this task of incubation. In some of these cases regular relief is afforded by each parent, but not in equal proportions.

The male and female of the hooded warbler take turns at sitting. Both sexes of the pileated woodpecker incubate alternately, and each shows a curious sort of interest in its mate by making it an occasional visit, and in its dainty way peeps in to see that all is well; once satisfied it flits away to find food. Audubon observed both the male and female warbling flycatcher to visit alternately though not with regularity. The male of the great horned owl aids his spouse in sitting upon the eggs. The task of incubation is performed by the male as well as by the female belted kingfisher, and with equal concern they guard the offspring. Each parent of the chuck-will's-widow family sits by turn.

Dr. Brehm cites in what way an unusual accident will bring forth the different amount of parental affection that is developed in each sex. He states that except for the ostrich he knows of only one instance in which the male (a pigeon) hatched the eggs and brought up the brood after the female had met with death. Dugmore, however, writes that if the female bob-white is killed after laying her eggs, the male bird assumes the entire duty of hatching. In general, however, in case of misfortune to the mother the brood is lost. Quite different is the state of affairs when the father comes to grief. In

case of such an occurrence the mother continues her loving care, and with cheerfulness is ready to undergo anything in behalf of her young. In some instances, nevertheless, the female has to be driven to the nest by the male.

Sometimes for weeks in succession parental affection continues so true to its task, so unfaltering in its purpose that the mother performs her duties, tedious on the whole, while the male perched close gives voice to his cheering song. Each egg must equally receive its amount of warmth; that none may be favored more than another, the old bird may be seen to arrange her priceless treasures, causing them either to lie with their points together or at least in a circle. Once a day it becomes her task to turn them. In addition, she must take care lest the sun beat down upon her eggs with too much warmth. In the nest of the spur-winged plover the eggs are surrounded with moist earth while the sun is very hot. The ostrich sits on its eggs only during the night, with few exceptions. The same may be observed with reference to the terns; undoubtedly, all the birds which lay their eggs in the sand follow the same routine, since there is the sun by day to afford them warmth. The mound-raising megapodes erect curious edifices for this purpose, which may

be considered regular artificial incubators.

"The power of maternal love, however, is all-powerful, and ever fertile in its expedients," (1) writes Brehm, and adds that in Africa he had discovered the greatest proofs of this. He gives as an example the pygmy swift which is known to build its "nest between the interstices of the palm leaves". (2) The nest here constructed is flat, and when the broad leaves are blown about violently by the wind, the eggs are apt to be thrown out. Such a catastrophe is never occurrent, for parental care has guarded against this great and foreseen danger. The bird sticks both eggs and young to the nest with her gelatinous saliva; and thus makes them safe. On occasion snakes plunder the nests of the mocking birds, either sucking the eggs or devouring the young, which may have hatched. At such times many mocking birds in addition to the parents put in an appearance and make their attack upon the enemy. Oftentimes they prove successful either in driving the reptiles away or even in killing them.

Care of the Young

The parent birds do not give assistance to the young when emerging from the shell, but once they

1 Dr. Alfred E. Brehm, Bird Life, p.327
2 Ibid.

are out they remove the empty shells, and warm the little downy fellows, making them dry and comfortable. The common hen furnishes an excellent example of this custom in birds. The female of the wild turkey raises herself half the length of her legs and peers carefully at the eggs. Clucking in a strange manner, she gently removes each half-empty shell, and finally with her bill caresses and dries her young.

For some time following the hatching for the most part birds do not leave the nest long, except when it becomes necessary to get food for themselves and their little ones, for they sense the need of the weak, featherless creatures. It may not be out of place at this point to mention the precaution that the wild turkey has been known to take in cold and rainy weather. To prevent the development of colds, the mother, according to some authorities, furnishes a "home remedy" in the shape of the buds from the spice-wood bush and with these "doses" her children.

The food at first consists of the softest objects possible to be found. The soft-billed birds supply food consisting of soft-bodied insects, such as grubs, caterpillars, maggots, worms, and creeping and flying things. Later, morsels with more substance may be brought. Birds of prey, for example,

in the beginning serve their young insects or half-digested meat; graminivorous species feed their young upon seeds that have been softening in the parents' crops. Or we may see them gathering insects which they sometimes beat into a pulp before giving them to their nestlings. Pigeons supply their young with "pigeon's milk", a sort of cheesy liquid that is secreted by the walls of the crop. With reference to the passenger pigeons Audubon gives the following interesting description of the feeding process:

> "The old bird introduces its bill into the mouth of the young one in a transverse manner, or with the back of each mandible opposite the separations of the mandibles of the young bird, and disgorges the contents of its crop." (1)

The high-holes and humming birds may be seen to pump food from their crops down the throats of their offspring. Each baby is fed what seems to be its share; then the next one is fed, and so on till the round is made.

The dabchick displays remarkable sense in the feeding of the young. A "catering parent" presented a large dragon-fly to one of its babies as it was being carried pick-a-back. Much too large was it for the little bird to manage, with the result that the brooding parent turned her head and removed it. In

1 John J.Audubon, Ornithological Biography, p.326

another brood a fish was brought for the young ones' consumption. As none of them could eat it, the father ate it himself. On still another occasion, as one young bird was lying on the nest and the other two were being brooded by the mother, the male swam around to the bird on the outside and gave it a shrimp. The young one found it an awkward object to handle, so the parent took the crustacean and crushed it well, whereupon the little one was able to dispose of it.

> "All the gallinaceous birds, and most of the marsh and water-birds, lead their young from the nest as soon as they are dry, and teach them to pick up their food by pretending to do so themselves." (1)

We may refer again to the common fowl which many of us have observed calling her brood to partake of some juicy morsel and in the midst of her ardent coaxing apparently indulge herself in hopes that her offspring may be tempted. Young water-birds are instructed in a like fashion; but grebes, and others of the better divers must spend a greater length of time before their young are fully trained.

There is an advantage for birds whose custom it is to feed their young from their crops; they are able to bring home an abundance of food at one

1 Dr. Alfred E. Brehm, Bird Life, p.329

trip and in so doing need not feed the fledglings so often. Thomson draws rather an amusing sketch of the penguin as it returns with its store of provisions. So filled with crustaceans is the bird's bill that it must lean back in order to keep its balance. Its shape, always quaint, becomes grotesque. Audubon is inclined to believe that the young of the belted kingfisher is at first fed upon food macerated and disgorged by the parents, and bases his belief on the fact that he noticed the old birds swallow, before entering the hole, the fishes that they had caught. Later on the young follow the parents about, and as they alight, excitedly flap their wings and with bills wide open beg for food. Before the white-headed eagle feels that its fledglings are mature enough to leave the nest it provides them with an abundance of food in the form of fish, either washed up on the shore or taken from the fish-hawk, not to mention rabbits, squirrels, and the like. One marvels to see the warblers, and other birds as well, carrying as a rule one insect, not more than a few, to the hungry mouths in the nest. A pair of goldcrests have been observed to make a trip for food every three minutes. Thomson states that a pair of great titmice destroyed between seven or eight thousand caterpillars during twenty days of rearing their young.

Many birds must remain in the nest till they are nearly mature; in such cases there is greater requirement for parental care than in the instances where the young leave the nest almost immediately. There is the ceaseless bringing of food; not only this but the nest must be kept clean. In general the raptores, crows, and a few others do not soil their nests; all other nestlings require the closest attention to keep their "cradles" in an immaculate condition. This means that the excreta must be taken from the nest, and carried away because of fear of discovery. The chimney swallow is extremely cleanly. The parents catch the excreta as it is ejected from the nest and carry it beyond the vicinity of the nest so that the ground beneath is left clean. Pigeons and hoopoes in this respect are especially negligent. Their young demand four times as much nourishment as the parents and it is possible that the old birds have little time for cleaning house.

It is always the mother bird, in cases where both parents supply food, which displays the most active responsibility in caring for the young. For example, we may hear the male hobby call its mate as it nears the nest, and see the female meet him to receive the captured prey and carry it home to

be divided between the young ones. The male of the sparrow hawk takes the more active part in searching out and overpowering its prey; but without the aid of the female he is decidedly handicapped, since it is she who tears the prey into bits of such proportions that the young can manage eating them. It is quite evident that dependence on the father's care would result in the starvation of the offspring.

With what courage, and cleverness, too, do parent birds guard and defend their eggs or young when danger threatens. Birds accustomed to building their nests in bushes or in trees disregard any dog which may approach their sanctuary, but it is quite a different thing when a cat puts in an appearance. All is excitement! The birds are thoroughly frightened and their cries fill the air and they dash madly to and fro about the enemy in the hope that they may distract its attention to some other source. Quite the contrary may be said to be true with reference to the birds which make their nests on the ground. In them is instilled a fear of dogs because the latter have learned how delicious is the taste of eggs and of little birds, too. Swallows, starlings, and even the sparrow, known for his shrewdness, are well aware that man does not harm them.

We are not unfamiliar with the American robin which flies back and forth, sometimes almost attacking the intruder; then it perches on a limb, paces back and forth, jerking its wings and tail, and utters a heartrending tone, expressive of its anxiety and displeasure. Carry off one of its young and the old bird will follow close behind joined by other birds of its own and other species. Attribute it as an act of cleverness on the part of the whitethroat to pretend lameness, that you may center your attention upon it and in so doing forget about a nest. In case of molestation of her nest the mother of the belted kingfisher has been known to drop down in the water, "as if severely wounded, and flutters and flounders, as if unable to rise from the stream, in order to induce the intruder to wade or swim after her, whilst her mate, perched on the nearest bough, or even on the edge of the bank, jerks his tail, erects his crest, rattles his notes with angry vehemence, and then springing off, passes and repasses before the enemy with a continued cry of despair." (1)

Beware of the birds of prey, peewits, gulls, and terns as they strike daringly both man and dog. In the event that one succeeded in reaching the nest of the red-shouldered hawk, far out on the bough of a beech tree and high up from the ground, and discovers that the female is sitting, one simply sees

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1 John J. Audubon, Ornithological Biography, Volume 1, p.396

her fly to watch from the distance. If the male is there with food for its mate, he begins screeching and launches an attack at the assailant so as to nearly knock him off the limb. Not at all pleasant is the oil which the petrel is able to vomit upon one who trespasses. The gannet takes no chances at leaving her eggs to the mercy of an intruder, but sits calmly thereon and with her beak fiercely attacks all comers. Not unknown to us are the tactics employed by the domestic fowl, and those of the ducks, geese, and swans. A swan will even kill an otter in defense of its young; while the farmyard cock is an expert in its disposal of a female sparrow-hawk, which can not successfully oppose its beak and spurs. Audubon expresses astonishment at the defense staged by the cliff swallow. He had been cautious at approaching, even though he felt that all the birds would be away at that time. A lone female was holding the fort. She called together her forces which attacked in a body, snapping at his hat, body, and legs and passing between their intruder and their nests, within an inch of his face, all the time sounding their feeling of rage and sorrow. Attacks were rained upon him as he made the descent from the cliff and even after he had proceeded some little distance.

Brehm has seen the "Black-headed Plover, on sandy islets of the Nile, adopt a singular method of preserving its nest: this clever individual, on the approach of danger, immediately scrapes the sand over its nest and then marches about close by, apparently in the most unconcerned manner." (1)

Observe the way in which an old hen musters her brood in times of danger. The grebe on such an occasion will even take her offspring under her wings and dive with them into the water; she has also been known to fly off with them concealed among her side breast-feathers.

Not infrequently, if they have experienced occasional molestation, will birds transfer their young elsewhere. Such is the behavior of the American kite. The same is true of the short-toed eagle. And even eagle owls act in a similar manner. The Woodcock is said to be able to transport her young by holding them against her breast with her beak and feet. One of the American goatsuckers succeeds in carrying its eggs to a place of safety within its broad mouth.

Some of the very intelligent birds seem to sense that they are no match for man in their weapons of defense and enter upon strange maneuvers to furnish their young with food at such a time as he may trouble their nest. It is known to be true

1 Dr.Alfred E.Brehm, Bird Life, p.332

that the hobby, kite, and carrion crow will drop food down from a height into the nest below.

The lesson of securing food as taught by the parent birds has its interesting angles, in particular among the raptores and aquatic birds. Brehm describes such a lesson given by the hobby hawk.

> "As soon as a brood of hobby hawks have learnt to fly decently, the whole family may be seen dashing about in the air, apparently engaged in a game of romps; this is, however, not the case, for the old birds are occupied in instructing, and the young ones are learning. At first the whole company go through a course of aerial gymnastics, the parent birds leading, followed by their offspring. The latter are then taught how to turn, put on a spurt, and strike, as well as other tricks of flight, until they are thoroughly well-grounded in the art. These preliminary measures having been gone through, the two old birds take their pupils between them, one parent rising above the young aspirants, and the other remaining beneath them. Suddenly, the upper hawk lets fall a bird it has already captured; all the youngsters dash towards it; the first misses the quarry, the second likewise; the third, however, is successful, and seizing the prey, flies off delighted full cry to the mother, to receive from her the well-earned praise. If all the young miss the quarry, it is caught by the old one circling below, and the game recommences de novo...."(1)

The grebes, of the water birds, continue their instructions for rather a long time. By way of a beginning the mother carries her children on her back, swimming about with them. What a jolt she must give them when she dives and they are shaken off such a comfortable place! While for a time food is distributed to the brood from the parent's beak,

1 Dr.Alfred E.Brehm, Bird Life, p.334

shortly it is simply laid in front of them on the surface of the water. Eventually, the prey is held up in full view at a distance; but as the young draw near, the old bird dives, inducing her offspring to follow suit. In case her pupil displays obstinacy and refuses to dive, the old bird seizes him under the wing, and unceremoniously dives with the little culprit to the bottom; this she continues to do until her offspring is ready to follow the trade of his fathers!

The young may remain in the nest till they have become able to fly; at this time they must leave their home. In case they hesitate to go, the parents, rather heartlessly in some instances, drive them out. Before being obliged to take such a step, however, "they have learnt the language of their parents, and are able to understand the different calls.... As the mother, by coaxing teaches the baby-child to toddle towards her, increasing the distance every time, so do the old birds seek to make their young extend their flight; food held before them first incites and encourages the timid little things to fly." (1) Under such tutelage the young robin is soon flying to a nearby branch, while the young swallow is gaining the top of the nearest roof. Now the old bird ceases to feed it as she sits close beside it. Down toward it she swoops and, as she does so, entices it to take a bite while

1 Dr.Alfred E.Brehm, Bird Life, p.333

it is flying. Till the youngsters are considered capable of enduring any hardships, the family continues to return for several evenings to the nest.

And so the young are instructed till such a time as they are able to look after their own protection and to secure food for themselves. In some species they either voluntarily leave the nest as soon as they are full grown or linger about it till the parents drive them away. In some species it is noticeable that the young associate with the old birds for some length of time. Sparrows, finches, and warblers trouble themselves no longer than two or three weeks about the fate of their progeny; crows and birds of prey harbor them a longer time; swallows and wild geese take their young with them when they migrate at the close of the season; long-tailed tits and partridges continue with their young to protect and advise them for nearly a year. As a general rule, it may be said that as soon as they have fully instructed their young in the ways of the bird world, the old birds leave them, or in some cases, drive them out to look after their own interests.

Chapter Nine

Parental Care among the Mammals

Parental Care among the Mammals in General

Among the mammals there exist all the various stages involved in parental care from the lowest to the highest forms in animal life. There is the egg-laying stage of the echidna and the platypus. There is the extremely undeveloped condition which may be compared to the embryos formed in partly brooded eggs. The offspring of the marsupials make their appearance in the world "naked, blind, deaf, and entirely helpless--mere motionless particles of flesh incapable of any voluntary movement." (1) Then among the Placentalia there are degrees of helplessness ranging all the way from the condition found among such creatures as those which are blind at birth, such as the rodents which must be cared for and protected by the parents for several days at least and sometimes for weeks, to a situation wherein the young in a few hours, as is true of the Ungulates, are ready to accompany the parents on their wanderings. Till at the top of the scale where there is special development mentally there

1 Eric F.Daglish, The Life Story of Beasts, p.117

prevails a condition, as in the Primates, making it necessary for the parents to guard and care for their young for several months; the young may even remain with the adults for a number of years, thus giving rise to a little family. Where there exists extreme dependability, there prevails a very noticeable amount of devotion and protection on the part of the parents. In cases where the young are able to accompany their parents very soon after birth there exists a limited expression of parental devotion.

Among the mammals, also, the number of the young tends to become reduced till we reach its extreme condition among the higher forms of the Carnivores and among the Primates where the usual number of offspring born at a time is one, not more than two. The highest form of parental care is therefore necessary to preserve the species.

Parental Care among the Monotremata

Two of the mammals, the platypus found in Southern and Eastern Australia and Tasmania and the spiny echidna, an inhabitant of Australia, Tasmania, and New Guinea, are the only known beasts that lay eggs. The echidna lays its one egg and places it in a pouch of skin on the under side of the body; here she harbors it till her young is hatched.

The platypus makes its home of security in a

burrow which it tunnels out from the bank of a river or stream, arranging an entrance under water. A large chamber at the inner end of one or more passageways is lined with dry grass and other herbage in the form of a cozy nest. In this environment the female deposits her two eggs, keeping them warm as would birds in general by covering them with her warm curled-up body. This she continues to do during the early nursing period. During the three weeks or more following the laying of the eggs till the beginning of lactation the female does not leave the nest. Burrell writes that the sleeping female lies with her tail turned over her abdomen, holding it against her tiny young; it is his opinion that the eggs are held in the same way.

This animal displays great cunning to keep her young safe. When she leaves she closes all the pugs behind her, making it compact with her tail as she goes. Burrell reports that once only has he noticed a mother to be absent from its young less than two weeks old.

"She attends to their physical well-being with meticulous care, reducing herself to a state of emaciation and exhaustion in the process". (1)

Otherwise she exhibits no real affection for her offspring, as she does not stay by to defend

1 Harry Burrell, The Platypus, p.186

them when the burrow is opened, her chief concern being only to escape.

Parental Care among the Marsupialia

Although the spiny echidna and the platypus are the only beasts, so far as we know, that lay eggs, there are several others whose young are born in such an undeveloped condition, and so small, that they may be compared with embryos that are present in eggs that have been brooded for some time. In this group belong the kangaroos, wallabies, phalangers, wombats, bandicoots, opossums, the koala, and the pouched mice.

As soon as the young of the red kangaroo are born the mother takes up her tiny babies (two inches long) by her lips and places them within a pouch on her abdomen, where they remain and are carried about until they can look after themselves. The newly born young, being in such a helpless, undeveloped state, can not even feed themselves. Not only must the mother place them in her pouch but she must also bring their lips in contact with the teats which are located low down on the body and inside the pouch. They are even too helpless to suck and the parent, by contracting the special muscles of the milk reservoirs, squirts milk down their throats. Later the young feed on grass as does the mother.

Mann observed that in one instance a young kangaroo was in and out of the pouch from December 1916 till February 21, 1917. At the end of this time the mother would not allow him to return, yet he had been permitted to stay till he was able to care for himself. He nursed, however, even when another young one was in the pouch.

A kangaroo mother in a circus exhibited exceptional solicitude for the safety and welfare of her son. When he first attempted to leave the pouch, she gently objected and with her fore paws restrained him from emerging. She objected to her son's going to a far side of the cage and kept him close by her. When pursued a kangaroo will throw her baby aside, probably in so doing to hide her young, making good her escape and later returning to its rescue.

"The mother kangaroo keeps her pouch clean by the use of her front feet, and her tongue, though the young are not always immaculate." (1)

Even after they leave her pouch, the parent licks her offspring with her tongue.

A mother opossum takes her half dozen or more infants as fast as they are born and drops them into the pouch, where each siezes a teat and holds on and the old one forces milk into their mouths. From

1 W.H.Sheak, Kangaroos and Their Young, p.98

this time on she must forage in the woods for food and at the same time protect herself and family as best she may.

When the young first make their appearance, with a couple of turns of their tails about that of their parent they become so anchored as to be able to ride safely on her back.

The young remain with their mother about two months. Occasionally a "brood of sucklings may be found in the pouch, while a second brood the size of rats may be seen on her back, clinging to her fur with their hands and steadying themselves by winding their tails around her tail and legs." (1)

The Australian koala gives birth to a single cub which it keeps in its pouch as a place of security. Following birth the young koala is in a very immature state and must be sheltered for several months in the above-mentioned manner. When it reaches a length of about six inches, it gradually leaves the pouch and spends its time in its mother's arms, and clasped by its mother who needs all her toes for hanging onto the trees, but clinging to her thick fur by means of its sharp little claws. The young assumes this position till large enough to protect itself. Should danger threaten, requiring actual climbing by the mother, the little fellow immediately clambers down her back, so as not to hind-

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1 Witmer Stone and W.E.Cram, American Animals, p.6

er her speed. Securely it holds on till a place of safety is reached. Thus the young continues till it is from six to ten months old before it starts climbing by itself.

The mother does not refrain from punishment, for she has been observed to cuff her young.

Some marsupials, as is the case of the banded anteater, never develop a pouch, but all the same they transfer their young to their teats where they cling very tightly and become hidden beneath the mother's body.

Parental Care among the Rodents

Parental Care among the Sciuromorpha

With respect to the squirrel we may find the most elaborate sort of nest. The latter is usually found in the fork of a tree and very high up from the ground. It is globular in shape with an opening so overhung with fabric or something similar to keep out the rain and wind that it is difficult to find. The nest may even be securely situated in a hollow tree or among rocks. It may be fashioned of closely woven fibrous roots or hay with leaves, moss, twigs, and the like interwoven. In a home of this sort the young are brought forth and cared for by the mother.

The young are found with the parents about eight weeks, but the male shows no solicitude in

their well-being till they are old enough to climb about among the branches of the tree. At such a time he may be seen, with his mate, escorting the brood from tree to tree. If it becomes necessary to move the young ones, the mother carries them clinging to her breast with arms about her neck.

"The mother beaver takes good care of her young and brings them tender plants and rootlets before they are old enough to leave the house. The father apparently remains away while the young are small, but in a large house" (1) at one time Bailey found two females, one male, and six good-sized young. The young beavers are said to stay with their parents for about two years, and during this time they are instructed in the many arts of which these beasts are masters.

Parental Care among the Lagomorpha

Among the rabbits and hares there are homes of different types. In some instances from the very first there is furnished for the young no other shelter than that afforded by the thick grass or leaves above them. What is termed a "form", which consists of "a space among the weeds and bushes where the grass, when there is any, has been trampled flat and perhaps slightly carpeted with loose fur." (2) There seems to be in some cases no entrance to the

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1 Vernon Bailey, Beaver Habits, Beaver Control, and Possibilities in Beaver Farming, p.9

2 Witmer Stone and W.E.Cram, American Animals, p.90

nest. A mat composed of dry grass so entirely covers it that the mother in visiting her young must crawl beneath this in order to gain an entrance. It so resembles its surroundings that one may easily step upon it before realizing it. The rabbit always covers the nest and young with a little blanket which she makes of fur plucked from her own breast every time she plans to be gone for any length of time to leave them. The cotton-tail rabbit sometimes makes use of a deserted burrow of a woodchuck or skunk.

We are apt to consider a rabbit as lacking in boldness, yet a doe at times displays the utmost bravery when an enemy threatens to do harm to her young. A stoat was observed to run swiftly from the entrance to a rabbit's burrow. Close behind it rushed the rabbit. The stoat turned and was on the point of attacking when the rabbit knocked it over. As the stoat moved backwards the rabbit charged again and knocked it over. After the fourth onslaught the stoat slunk away. The brown hare will fight for her young. A squeal on the part of one of her leverets brings her to the spot, all ready to offer defense against a cat or stoat as may be necessary. Seton relates a story of a little cottontail's experience with a snake. When the snake took him by the ear the little fellow screamed and his

mother came running to him. She struck at the snake with her hind claws until at last it released its hold on the young one.

As she goes to and from her form-where lie her young it is with the greatest care that the mother breaks the line of her scent. She may be seen to back-track for a distance, so that the trail ends abruptly; then she makes a big leap to one side or the other and repeats this performance.

The young are given little or no training by the mother and leave her at an early age.

Parental Care among the Chiroptera

Seton pictures a mother bat carrying her two offspring clinging to her breast as she skims about catching food. At such a time as they become too heavy she leaves them in the den in a hollow branch or hangs them on some twig to return to them later. At the beginning the mother of the brown bat feeds her young from her breast as does a mouse except that she cradles them in her soft wings while doing so. Later she brings them moths and June-bugs for their two meals daily, one in the evening twilight and one in the morning twilight. As soon as they are old enough the winged fellows must learn to secure their own food. The mother holds food in sight and then flies into the air to entice her young to

follow and so learn to fly. In case of faintheartedness on the part of her offspring, the parent glides beneath them and holds them upon her back. Much apparent scolding seems necessary before the little ones learn to fly.

The epauletted fruit-bat carries its lone offspring hanging from her abdomen with its claws, while with its mouth it holds fast to a teat. It keeps a close grip and nestles so snugly as to be invisible, unless one is close by it. Between flights the mother folds the little one beneath one or both of her wings, where she hides it and also keeps it warm and dry. Under such conditions it is suckled by the mother till it is sufficiently developed to fly and care for itself.

Parental Care among the Ungulates

The habits of the members of the deer family are so similar with respect to care for the young that any one species might be taken as an example. The red deer, the white-tailed deer, and the mule-deer all take the same precaution in connection with a place of birth for their young. Batten speaks of the red deer as usually dropping its young in deep heather where it leaves it till evening. The white-tailed deer leaves its fawn in a similar location. The mule-deer hides its young at different points in

the same thicket. The elk seeks out some quiet hollow wherein its fawns are born and forthwith concealed. The cow moose as well conceals its young and never goes far afield while its calves are in hiding. In each case the mother is always within close range.

It is with the utmost precaution that the doe steals to the spot where the young is in hiding. Having assured herself that all is well, the hind of the red deer goes by devious ways to feed its fawn. The mother of the white-tailed deer visits the young perhaps a half dozen times a day and suckles them. The mule-deer comes to feed its offspring in the early morning and late evening. The elk lurks nearby and suckles its young at times, while the cow moose at proper times attends to suckling its young. And thus the young remain in concealment and are given nourishment till they are able to follow the parent wherever she may go. In some instances the doe need wait only a few days till its young gains strength to follow the others. In others, as is true of the mule-deer, a period of six or even eight weeks passes by before the young are allowed to follow. During this time the parent is always within close call to minister to any needs, leaving only long enough to secure water with which

to quench its thirst.

The vigilance and devotion of the mule-deer at this time are most admirable. The same may be said of the red deer, the prong buck or of the moose or elk. The mother of the red deer makes her fawn lie down by pushing it gently with her forehoofs, and when she has left, it will not stir on the approach of danger until actually touched. The mule-deer teaches its young to slink into the grass and skulk as low as possible at the sound of her whistle. Seton believes that the white-tailed deer lies down next to its young to keep them warm by night, although the available evidence shows that by day she occupies a bed apart. The latter, if the case, undoubtedly is evidence that the mother lies ready to attract the attention of any intruder to herself and thus shield her young from harm. Seton says of the mule-deer, "Every danger is studied, and every creature that might injure her little one is either fought or misled to the utmost of her powers." (1) Should her little one utter a cry of distress the hind of the red deer at once puts in an appearance, wide-eyed and stamping, prepared to fight valiantly in its defense. Her attack, too, is very formidable,

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1 E.T.Seton, Life Histories of Northern Animals, Volume 1, p.128

for she never fails to use her sharp forehoofs with deadly effect; and woe betide the wild-cat or prowling dog that falls foul of her defensive! When wolves discover and attack its young, the prong buck

> "then displays the most devoted courage in their defense. She rushes on them, butting and striking with her short horns, and sometimes tosses a wolf heels over head; she also uses her forefeet, with which she deals severe blows, and if the wolves are not in strong force or desperate in hunger, puts them to flight, and then seeks with her young a safer pasturage, or some almost inaccessible rocky hillside." (1)

A rustle or a squeak is enough to make the white-tailed deer dash excitedly to the quarter whence it came.

An Indian guide relates a story about a cow moose. It had entered the lake with its calf and was swimming to the opposite shore when from another direction a black bear slipped into the water. It was very close to the calf before the moose realized it. Immediately she attacked it with her four feet and overcame it. Upon investigation the guide discovered that the bear's back had been broken by the blows from the moose's sharp hoofs.

The fawns of the red deer follow the dam till autumn. If the mother then joins the herd of a master-stag, the male fawns are apt to be forcibly

1 Audubon and Bachman, The Viviparous Quadrupeds of North America, Volume 2, p.107

ejected by the stag who is jealous of all other males, and from then on are compelled to fend for themselves. The hinds, however, are often suckled by their mother for a year.

> Some authorities believe that the "doe takes care of its fawn until time for the new babies to come, when she quietly slips away from the yearling.... Sometimes she will allow her yearling to go with her again after her new ones are a few days old,...." (1)

> "Even so timid and inoffensive a beast as the tapir, which normally hides itself away in the thickest parts of forests to avoid encounter with enemies, and will take to flight before an animal very much smaller than itself, when its young is at its side will rush blindly at anything which threatens it, bowling its adversary over by the momentum of its charge, and trampling on and biting savagely at the fallen foe." (2)

Parental Care among the Carnivora

Among the cat family the father usually is either indifferent or hostile to its offspring. In many species, as is true of the domestic cat, the dam finds it necessary to afford protection to her little ones against the male who, if not prevented, will enter the lair and devour them while in their stage of blindness. Undoubtedly such a condition accounts for the origin of the custom that prevails among feline mothers of hiding their little ones. The domestic cat is known to conceal her offspring in such places as partitions of the house, beneath

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1 California Fish and Game, Volume 17, Number 4, p.464
2 Eric F.Daglish, The Life Story of Beasts, p.131

floors, in closets, haymows, etc. When in the wild state, the mother leopard carefully hides her cubs in caverns, under roots of trees, or in thick bushes till they are strong enough to accompany her. The jaguar searches out a thicket of the forest which can not be penetrated, or a pit beneath a half-uprooted tree, as a den for herself and children.

For a few days the mother leaves her young only for a short time, if at all. If they seem to be in any danger (This is true of the jaguar.), she carries them in her mouth to another place of concealment.

At an early age the kittens, or cubs, take great interest in the movements of the mother's tail. Soon they are chasing it; the mother, not at all disturbed, continues wagging her tail for the amusement of her offspring. After a few weeks the mother enters into the wildest and liveliest kinds of romps with them, it making no difference whether she is a "stately lioness or one of our domestic Pussies." (1) This sort of play leads up to lessons in securing food. Small animals, sometimes active live ones, at other times those that are about dead,

1 Dr.A.E.Brehm, The Life Story of Beasts, p.90

are released, upon which the young practice their tactics in pursuing and handling their prey. Eventually, the little family sallies forth on a hunt where the young receive the most thorough kind of instruction in all sorts of tricks.

A feline mother with her young presents a very pleasing picture. She expresses motherly tenderness and solicitude in every gesture and in every sound, her voice being gentle and surprisingly soft. So untiring is her watchfulness that there can be no doubt as to her absorbing affection for her offspring. Let a foe put in an appearance and she is immediately on the defensive, entirely disregarding her own life. On such an occasion the mothers of all the larger species are decidedly dangerous. The motherly love of the jaguar leads her to defend her young with a kind of frenzy; if one of them is killed or taken from her, she follows the assailant for hours. Seton describes the mother panther's love as being as proverbial as is that of the mother cat. Her love is the "climax and measure of heroic devotion." (1) Hunters hold that the panther might have been the inspiration for the lines written by Sir Walter Scott:

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1 E.T.Seton, Lives of Game Animals, Volume 1, Part 1, p.89

"Like mountain cat that guards her young
Full at Fitz-James' throat he sprung."

Seton tells the story of a friend, who, while camping in Wyoming, found a couple of panther kittens and took them home. The next afternoon he noticed the mother coming stealthily toward him, her eyes glaring and her tail twitching.

When her young were strong enough to climb some stairs leading out of the cage, a lioness brought them up for an airing. A leopard becoming interested pounced upon the kitten. In an instant the mother was on the leopard's neck and clawed his head several times before she followed her kitten home.

The foxes in general prepare a den of the most secure type in which to bring forth their young. In the mountains of the north the red foxes dig their den so that a root or a boulder may serve as an obstruction a short distance from the entrance, and within, beyond which no one can force an entrance. Off the main burrow are side pockets in which the young are hidden so that one digs into the burrow past them, thus throwing dirt onto them. The gray fox hides its young in a nest of leaves at the bottom of a hollow tree, and later brings them out to give them lessons in hunting and in living in

the great out-of-doors.

Every infant fox is taught the lessons of life by its parents. First they are taught to use their noses; the parents, having brought food for them, hide it some little distance from the den and leave the cubs to locate it by their own keenness and cleverness. A little later they are taught to pounce mice out of the grass. They are taught the folly of chasing the fleet-winged grouse. Above all things they are taught to consider that stealth and cunning must be practiced by them at all times.

Man's footprints become to young foxes a cause for the greatest precaution. The mother instills fear in her young ones by taking them to a fresh track some distance away. She sniffs at it, then bristles and growls, casts her glance this way and that, finally sneaking swiftly into the bushes, ever keeping to the hollows, never appearing against the sky line. The cubs follow carefully her every movement.

Seton pictures the home life of the red fox as being ideal. Few animals compare with it in love and devotion where the offspring are concerned. Even though he is not allowed in the den for a few days following the birth of the cubs, the male stands on guard and brings food to his partner. He dis-

plays great affection for his offspring and later he shares with the mother the task of feeding and caring for them. The male of the Arctic fox leaves home a few days before the young are born, but returns as soon as their eyes are opened to assume his share of the responsibility of rearing the offspring. He brings home game, preferably birds, as soon as the cubs are big enough to eat solid food.

The red fox provides a yard in which its young may play, apparently so that they may gain a broader outlook. This is a little distance from the mouth of the den and sufficiently secluded in the midst of thick bracken or some similar location, and within easy range of the den. From her bed at the side the parent watches her cubs at their rolling and scuffling. Let one attempt to wander away and he is called back at once, apparently to be severely reprimanded. In its nursery the fox cub is furnished with playthings, such as the wing of an old cock grouse.

Parent red foxes often display a great degree of fearlessness and cunning in their attempts to lead any intruder from the vicinity of the family.

No animals can display greater love for their young than do some of the bears. At birth the helpless cubs are protected inside a securely situated

den, usually in a cliff. The polar bear digs a cave in the snow or lets the snow bury her. In this environment the young are born, and for several months the mother remains in her hibernating quarters beneath the snow, gaining air through a sort of breathing shaft that is kept open because of the warmth from the bear's body. During all this time the only source of nourishment for the cubs is from the mother. Her offspring grow strong and vigorous, while she, with no supply of food, appears in the spring in an extremely gaunt condition. Skinner in speaking of the bears of the Yellowstone Park relates that the eyes of the young are closed for forty days; not until the end of two or three months do the cubs leave the den, and all this time the mother lies asleep in hibernation. The grizzly of Alaska gives birth to blind, toothless, and for the most part hairless cubs. She curls around them, keeping them as securely enfolded as if they were in a pouch. For several weeks following the birth of her young she leaves the den for neither food nor drink.

At the close of the period of hibernation, which is at the time when the young can see and walk about, the little family comes forth from its place of confinement. The mother bear is very solicitous

for their safety and endeavors not only to protect them from the other bears but also from any other source of harm. In fact, she usually refrains from leaving her den till a month or so following the emergence of the male bears and those females who are without young. The male bears are cannibalistic whether they are fathers or strangers.

The grizzly mother is extremely cautious the moment she scents an enemy. She at once seemingly spirits her cubs away out of danger, or attempts to lure away her pursuers from the vicinity of her home or cubs. Mills tells of a grizzly which led her pursuers twenty miles in such a case as this.

On one particular occasion having rescued a dead cub, a grizzly mother is pictured as licking its body till clean and then laying it down to gaze at it in a puzzled manner. She later lifted it very gently, then pawed it about apparently with the idea of awakening it. After placing it against a boulder, she continued watching it as she backed away and turned to search for a second cub. The second cub found, she lifted it and hugged it closely to her.

The old brown bear leads her cubs everywhere. She teaches them many things, such as how to dig bulbs, how to catch mice, where to find ants, and

how to knock frogs out on the bank. The black bear also escorts her little family all over the woods, all the while teaching them all that they must know in order to be able to look out for themselves. She gives instructions in the art of mice catching, of ant digging from a rotten log, and of slapping bull-frogs out of the water, and of fishing.

In the midst of great hardship, although in a weak and starving condition, polar bears have been known to divide among the young the most of the food that they have secured after many hours labor, reserving but a meagre portion for themselves. A female polar bear eagerly caught lumps of blubber thrown to her from an icebound ship and carried them to her cubs. As she was making one of her trips back to her young she was shot and mortally wounded. In spite of the fact that blood was streaming from her body and in spite of the fact that it was with much effort that she could reach her young, she dragged herself along to her cubs and tore the food into equal portions for them to devour. Shortly afterward she was dead.

Polar bears display their grief at the death of a cub, and if they realize the cause of the death as being from injury, they become especially furious. Brown and black bears as well pursue an

enemy, who has injured their young, for days, and travel miles that they may avenge the death.

The story is related about a mother grizzly's rescue of her cub. A range-bull was about to injure the latter when with a roar and a bound the parent was upon him. He bent his head to tear her with his horns, but she, too quick for him, dealt him a powerful blow and then leaped upon his shoulders, tearing the flesh from his ribs with her murderous claws.

Old bears play with their young, entering into the most sportive frolics, repeatedly pushing them over with their paws. After her cubs had jumped upon her back one old grizzly waded with them into the water and spilled them, leaving them to swim ashore. As another grizzly mother leaned against a stump, her head between her two cubs which were upon the stump, she occasionally pushed them off with her paw or nose. Now and then she grunted as if talking to her babies. In spite of the fact that her cubs may play all sorts of tricks in order to worry her, an old bear continues to display the greatest affection for them and guards them with the utmost jealousy.

The grizzly mother is considered the greatest wild mother in the wilderness. Her keen sense and

capable brain lead her to keep her young from danger. Although not ferocious under ordinary circumstances, in the face of danger she defends her cubs with skill, endurance, and courage unless there is an opportunity for her to retreat.

When the cubs become older the old bear does not hesitate to cuff or spank them in case of disobedience. It may be that they do not move quickly enough; then she calls sharply to them or, if it is necessary speeds them up with a cuff.

As regards the grizzly, no full grown bears appear to hibernate together with the exception of the mother and her yearling cubs. During the year the family travels by itself and the mother lavishes her attention upon her offspring.

With respect to the smaller Carnivora, such as skunks, weasels, stoats, raccoons, and others, the display of parental affection exists to a very definite degree. Homes are prepared for the young and much solicitude is displayed toward them. Skunks are born in a larger portion of the burrow upon a soft bed of grass which the old one keeps spotlessly clean. Young raccoons, blind and helpless, receive the guardianship of their parents for a year, or until they are fully matured. A devoted weasel mother has been known to return in the face

of gun fire to rescue one of her young which has been too seriously injured to follow.

The otter presents a remarkable example of a parent among the smaller beasts. It usually makes a burrow in a bank, this burrow having its only entrance beneath the water and covered by roots of timber. The mother scarcely leaves the cubs except for necessary food. For eighty days she cares for her two or three young ones, which are blind for over a month. She feeds them upon her milk, while the guarding is attended to by the father. At the end of this time the mother digs an exit to the dry land and leads them forth, usually at night.

Then must come the initiation into life in the water, at which time the parents carry their young into the pool, tip them off, and leave them to fend for themselves. Yet, at times they are allowed to ride for some time upon the parent's back.

The children get the benefit of an elaborate education. The mother teaches them the meaning of certain sounds, punishes any disobedience or foolhardiness, instructs them till they become expert swimmers, and shows them how they may lie quiet beneath the bank of a pool while only their nostrils extend above the water. She teaches them how to catch trout and frogs. She impresses them that an

eel must be eaten from the tail end, but the trout from the head, and that a frog must first be skinned.

Both parents bring food to the young and both likewise seem devoted to them. They are ever guarded by at least one of the parents. A hawk or an owl receives its warning by a snarl or a hiss. In case there is high water or a landslide, or a man threatens their offspring, the parents carry them one by one to a faraway den.

The sea otter gives birth to its young on land, and suckles it for nearly a year. In the sea or on the shore it carries its cubs in its mouth; and when asleep at sea it folds its young in its arms.

To teach the young the parent throws its offspring into the water, but comes to their rescue as soon as they appear to be tired out and brings them back to the shore.

The affection with which an old otter embraces its young is almost unbelievable. It ducks the young one's head into the water to deaden an outcry which may betray its whereabouts. If pressed by hunters, it takes its young in its mouth and does not release its hold till extreme necessity, or death, compels it to yield. When its young is taken, it immediately sets up a wail.

"Seals are among the most affectionate of par-

ents. The giant walrus is at most times despite its size, a very gentle and harmless creature, but if the young are threatened it becomes at once transformed into a most formidable beast. Not only will the female defend her little ones with grim determination, but if she is wounded in an encounter the other members of the herd will take up the fight, falling in a body on the foe responsible for the hurt suffered by their comrade. The bladder seal also will fight to the death should its young be molested, refusing to leave its pup no matter how severely injured." (1)

The mother walrus displays the greatest affection for its young and seems to repair with them to the shallowest inland waters in which they can float with difficulty. The seal suckles its one youngster and rears it with much tenderness. After it has been taught to swim, it is then left on the shore till its coat of fur has fully grown.

Parental Care among the Primates

"Parental emotion is more impressive in the primates than in the other types of animals, and increasingly so from the lower monkey-like animals to the great apes. No monkey mother will ordinarily allow a baby, even though it be dead, to be taken from the cage." (2)

Cacusa, a mother chimpanzee, refused to let her dead child be taken from her. Finally a cord was placed about the offspring's neck and concealed so that the mother might not see it. While Cacusa was being caressed and thus her attention diverted from her child, the cord was pulled and the baby

1 Eric F.Daglish, The Life Story of Beasts, p.131
2 Robert M.Yerkes, Almost Human, pp.127-128

thus taken out of the mother's arms. Brehm has seen apes in captivity divide everything with their young. The death of the child is usually followed by that of the mother, which gives every appearance of dying because of a broken heart. Madame Abreu tells this story of a young baboon's being taken from its parents. As soon as he was returned to the cage, both father and mother rushed to him and carefully inspected him. When satisfied that he was not harmed in any way, they appeared much relieved and contented.

The gibbon takes the utmost care of its young one. She takes it about clinging to the under side of her body for many months. She seems to be in no way annoyed as the baby hangs on and she walks along as if she were carrying only her own weight. The baby chimpanzee is regularly carried, guarded, and protected by its mother. From the very first it clings closely to her and later, having become able to walk, it rushes to a place of safety on her back whenever danger seems near or at such times as its mother calls. Monona, a chimpanzee owned by Madame Abreu, commonly walked quietly about her cage with baby Lita seated firmly on her back and upright, holding on with her feet only, except in cases of alarm when she would press close against her mother's

back and hang on firmly with both hands and feet. Likewise the mother gorilla carries her young mounted on her back, with its arms about her neck and its feet hooked in her armpits. Thus she continues to carry it the most of the time, clasping it to her bosom. She oftentimes coddles it in her two arms as does the human mother.

Fitzsimons speaks of several velvet monkeys, or apes, that had been wounded. Among them was a mother who had been struck in the lower part of her back which resulted in the paralyzing of her hind quarters.

> "She clasped a baby in her arms, and was begging piteously for life--for the life of her child. Casting both arms around it, she made the most frantic efforts to shield it with her body. Looking over her shoulder she glared at her enemies, the muscles of her face assuming a variety of forms, and her teeth glittered in the early morning light." (1)

Such is the mother monkey's affection for her baby that she is completely mastered by it. In moments of danger, quite forgetful of self, she displays her anxiety for the safety of her offspring. An ape climbed into a tree whither she had been pursued by dogs. A hunter following the dogs raised his gun to fire. The mother placed herself between

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1 F.W.Fitzsimons, The Natural History of South Africa, p.7

the gun and her child and received the charge in her back. She fell to the ground; she sheltered her young one, still seeking to protect it with her body. As she hugged her baby, she regarded her enemy with a pitiful look in her eyes; then with a gasp and shudder she died.

In another instance a monkey with twins kept them constantly in her sight for the first few weeks. The appearance of a dog caused her to snatch up her children and hold them closely, and to utter loud cries of threat. When at last the twins led an existence quite independent of their mother, they would, till almost adult, rush to her for protection whenever they were frightened. A friend of the owner of two monkeys, each with a child about a month old, brought with him on a visit his dog. The latter burst forth in barking as soon as he saw the monkeys in a tree. One monkey passed her baby to the other, which took a more secure position. Thereupon, angry and defiant, she stood ready for battle and gave vent to loud bark-like cries.

The adult female chimpanzee is a dangerous antagonist if aroused to defend its young. As the baby plays with persons beside the cage, either father, mother, or both watch closely, ready to rush

to its aid should harm threaten. The female baboon will avenge the wrongs done to her child by attacking the father who because of his jealousy of the baby becomes cruel. A pair of baboons were in a cage together with their several-months-old baby. The father had become unkind to the child, not only beating it roughly but occasionally biting it. Shortly after the little one was put by itself the father was found minus one eye, and the mother came into power.

Yerkes relates in connection with some of Madame Abreu's chimpanzees that "Lita, although not entirely dependent on her mother for nourishment, was still treated by Monona the mother as though nursing. The evidence, then, seems entirely to substantiate the common statement that the female chimpanzee nurses the baby for several months, even perhaps for a year or two, and that for several years the young animal continues with its parents, constituting a partially dependent member of the growing family group." (1)

Following birth everything would indicate that the male and female chimpanzee behave as appropriately as do persons, and are no less indicative of altruistic motive and devotion to their offspring. There are apparent no instances of ill treatment on the part of the male of either mother or infant. In consideration of all that Madame Abreu has learned about chimpanzees and in consideration of all that

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1 Robert M.Yerkes, Almost Human, p.190

literature offers concerning them theirs is a typical family.

Very early there comes the period of tuition. Madame Abreu is quoted as having seen a mother chimpanzee on three occasions take her little baby by the arms and try to show it how to walk, beginning her instruction when the infant is about two months old. Previous to this the child had been taught many things and trained in various ways by parental example. In beginning her instructions the mother held the little fellow above the ground, with his legs dangling in the air attempting to gain a foothold. In this manner was an opportunity afforded for practice in grasping and holding. Most interesting of all, however, were the child's attempts to walk. The mother stood near to take the young one by the hand, thus forcing him to walk on three legs, or she would place him in front of her again and lead him.

The chimpanzee displays toward its young a noticeable combination of firmness, tenderness, skill, and care. The mother may at times be impatient, yet except where conditions are abnormal she does not appear vindictive or neglectful. She punishes when there is due cause and "one may approve her implicit confidence in this pedagogical method, even though

he doubts its efficacy in his own species." (1) The mother ape allows her young to play and frolic with its little friend, yet always keeps her eye upon it, following in its footsteps and allowing it only a certain amount of freedom. If danger threatens, she utters her sound of warning to her little one to retreat to her breast for safety. Disobedience results in a slapping, or a boxed ear. The gorilla, too, corrects her young, occasionally chastising it.

The length of time which parents exhibit affection toward their offspring has wide variation. Yet, whether this period be a long one or a short one, all beasts nurture their young as long as it is necessary for them to be helped and protected.

> "No beast is ever sent adrift before it is in a fit state of development and strength to face the grim struggle for life in which it is destined to play its part, just as no baby beast is born into the world in a condition likely to be prejudicial to its ultimate chance of survival." (2)

1 Robert M.Yerkes, Almost Human, p.191
2 Eric F.Daglish, The Life Story of Beasts, p.134

Summary

In this paper an attempt has been made in a broad way to trace the affection, or apparent affection, which parents of the animals in both the invertebrate and vertebrate kingdoms display toward their young. As expressive of parental care there has been taken into consideration every evidence on the part of the parents, male or female, or both, either previous to or following the birth of the young to display the least sort of solicitude for their young. Even in those instances where arrangements are made for the safety of the eggs during development, reference has been made, in spite of the fact that the parents in some of these cases never live long enough to afford any care for their offspring. In the latter respect, however, comparatively little, except casual, mention has been made of these cases. Attention has been given to the making of nests in which the eggs can be deposited, or, as is the case of mammals, to the selection of a suitable place where the young can be brought forth.

Instincts leading to the care of the young and the significance of these instincts have been discussed to some extent in order to trace the origin of the institution of parental care, that ex-

pression on the part of the parent which springs from the consideration of and devotion for the young. Finally, the importance which may be assigned to parental care has been noted. To the care which parents exhibit toward their young may be traced organized societies. Even among some of the insects, such as the bees, there may be traced the various steps between a single family and the highly organized social state. To parental care we may trace the source of the altruistic instinct. This care, too, which parents show for their offspring is one of Nature's devices for race survival.

The appearance of parental care has been a gradual one. At first there seems to be among some of the insects mere instincts that have as their goal the securing of a proper environment for egg development; therefore, we find insects that deposit their eggs upon a food plant, upon decayed matter, or upon another insect, and so on, that their eggs may not only develop but that later on the larvae may have a source of nourishment. Then, as in the case of some of the solitary wasps, there is foresight in providing for the needs of the larvae by placing food with the egg. As in the case of some of the cold-blooded vertebrates and the birds, there prevails the continuous care for the eggs af-

ter they are deposited. Finally, there is the extension of the care from the eggs to that which hatches from them.

Among the lower invertebrates, beginning with the crustaceans, we find that the number of eggs is reduced to a considerable extent and that the mother seeks to attach her eggs to objects beneath the water. Some of the crustaceans even carry their young about in brood pouches, or, better still, attached to their bodies. Some of the spiders fashion elaborate cocoons in which to carry their eggs about with them, and later on transport their young on their back. Other spiders go so far as to resent an intrusion upon the sanctuary in which the young are located.

Some of the beetles prepare galleries in whose niches the young hatch and are fed and attended by the parents. We observe the solitary wasps and bees to make homes in the soil, in wood, out of mud or paper in which food is placed for the larvae.

The social insects are more actively solicitous for their young. To be sure, the parents do comparatively little in caring for their numerous offspring, but the workers act as their very efficient substitutes, lavishing all care that is necessary upon the eggs, larvae, and at last upon the

fully formed insect. Here belong the hive bees, the bumble bees, the ants, and some of the wasps, ever busy as they fly about to ascertain that every individual is receiving the proper amount of attention by way of care or nourishment.

The amphibians for the most part are neglectful parents after the eggs have been deposited in a suitable environment. At this time very few remain to guard the eggs, perhaps due either to the fact that while the young are aquatic the parents are terrestrial or to the fact that these animals have low mentality.

The reptiles display a reduction in the number of their eggs. Brood care seems to be almost wholly limited to the formation of a nest or burrow to hold the eggs whose traces are destroyed as soon as they are deposited. The females guard the young to a small degree following their appearance, but the male is an entirely disinterested creature as far as they are concerned. Some of the crocodiles are said to linger about in the vicinity of the nest and to attack any intruder. They assist their young as they emerge from the nest. These crocodiles even guard the little ones after they reach the water. A few of the snakes, as the boa and the python,incubate the eggs by coiling about them, but as a whole snakes are fast approaching

the state where the eggs are retained within the body till the time of hatching. Some species of snakes are reported as protecting their young.

Of the fishes there are many that lay thousands of eggs and immediately leave them. Others deposit their eggs inside objects such as shells, pipes, and tubes and protect the eggs till the young appear. Fishes of various types, the numbers of whose eggs are reduced, carry the eggs and young about with them. Arius hatches the eggs in its mouth, while the sea horse keeps them in an external pocket till they hatch and mature. In nearly all cases it is the male who assumes the responsibility for the care of the eggs and the young. The lungfish and the lumpsucker are known to drive intruders from the nest. When the young hatch, however, the parent's concern disappears. The toadfish and the bowfin of the Great Lakes guard their young for some time.

Birds in general exhibit a remarkable picture of the care that parents bestow upon their offspring. The instinct to incubate appears to a marked degree. Some authorities consider that this instinct resulted from an instinct to remain where the eggs were left in order to protect them. This protecting instinct devolved into a true instinct and because of warm-

bloodedness, occurring during the evolution of birds from reptiles, the supplying of heat became indispensable for development. We find that many of the birds sit diligently for days, and weeks, too, upon the eggs, oftentimes depriving themselves of the necessary food during this time. As soon as the young hatch the old birds display the utmost concern for their welfare. Food is brought to them in abundance. Protection is afforded them on every necessary occasion. It is usually the mother bird whose devotion is outstanding; sometimes it is the father; and in many species it is both the father and mother who share in the care of the offspring. The males of most of the primitive birds--the emu, cassowary, rhea, and kiwis--are extra-fatherly.

According to the species of the bird there is either no nest or a special kind of nest, simple or elaborate as the situation may demand. In the less evolved species, to which belong the different kinds of water-birds, the eggs are laid and incubated in the ground. Gulls, sandpipers, and plovers deposit their eggs in the ground, with the addition of a breastwork of leaves. The brush-turkeys leave their eggs to hatch in a loose heap of earth. Some of the mound birds bury their eggs, while others place a hot bed of dead leaves over them and leave them to

hatch, an act which reflects back to the reptiles. Then there are the burrowing birds, which seek out holes in trees or deserted burrows in the ground as a nesting place. The higher song-birds carefully prepare a nest in which to hatch their young, a nest to provide warmth and comfort, as well as protection from enemies.

With the exception of the rodents and a few of the carnivores the number of young born at a time among the mammals is still further reduced from that found in birds, necessitating a marked degree of parental care in order that the species may survive. There are a few mammals which represent the egg-laying stage, for example the echidna and the platypus which lay one or two eggs at a time. The young marsupials represent an extremely undeveloped condition to be compared with embryos in partly brooded eggs. The Placentalia exhibit various degrees of helplessness. The rodents are blind at birth and must in some cases be nourished and guarded for several weeks. Among the Carnivores there also prevail blindness at birth and helplessness for some time, making it necessary for the parents to give special attention to the welfare of their young. The Ungulates, however, are able to see at the time of birth and to walk a few

hours later, a condition quite necessary in the case of those animals which wander about in search of their living and who would find it difficult to conceal for any length of time offspring that were helpless even for a few weeks.

It is evident that the length of time that parents display affection for their young varies widely. Some of the rodents suckle their young for a very short time. The camel suckles its young a year or more and the walrus for two years. Hippopotami allow their young to stay with them, and give them milk for several years. Rhinoceroses have been seen to suckle their young when the latter were six years old.

Thus, from some of the lower invertebrates to the highest forms of the vertebrates there exist various degrees of care and devotion bestowed upon the young. The provision made by the lower insects for their progeny plays as important part with reference to these particular individuals as does the unmistakable love which is expressed by any of the Primates for their offspring. Devices employed in either situation are required that the destinies of the race may be well-provided for. There is parental care in each case, but of different degrees of intensity; yet always, it seems, of whatever

kind, the simplest or the most outstanding, parental care provides for the needs of the individual till the time when it no longer needs assistance as it enters upon an independent existence.

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